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# ABSTRACTS

of recent published material on  
Soil and Water Conservation

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UNITED STATES DEPARTMENT OF AGRICULTURE

The articles in "ABSTRACTS of recent published material on Soil and Water Conservation" are abstracted by Charles B. Crook in the Soil and Water Conservation Research Division of the Agricultural Research Service.

The ABSTRACTS are issued at irregular intervals. Their purpose is to bring together a summary of current published information about soil and water conservation work. Reprints of abstracted articles are generally not available in the Division. Requests for reprints should be sent to authors or institutions--addresses are appended.

The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When an entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses follow U.S.D.A. Misc. Pub. 765, July 1958.

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# WATERSHED ENGINEERING

## Watershed Development

Morisawa, M. E. QUANTITATIVE GEOMORPHOLOGY OF SOME WATERSHEDS IN THE APPALACHIAN PLATEAU. Geol. Soc. Amer. B. 73: 1025-1046. 1962.

Geometry of 15 watersheds in the Appalachian Plateau province conforms to Horton's laws of drainage composition in horizontal, or planimetric, properties but not in vertical, or relief, properties. Geologic structure and varying lithology interact to change vertical form elements and cause deviations from Horton's laws.

Geometric similarities and differences in watershed morphology provide both quantitative and qualitative bases for grouping the regions studied into three distinct sections. Dissimilarities, although distinct, are not great.

Simple correlations of hydrologic and geomorphologic features provide the basis for choice of characteristics to use in a multiple regression on peak-runoff intensity. A regression of peak intensity of runoff on basin area, rainfall intensity and frequency, and topography has a high correlation coefficient and is significant at the 0.001 level.

Route 202, Towaco, N.J.

## Hydrology

Wellisch, H. A SELECTED BIBLIOGRAPHY ON FLUID MECHANICS, HYDROLOGY AND HYDRAULIC ENGINEERING, 1950-1960. Tahal Water Planning for Israel Ltd. 69 pp. 1961.

A bibliography of books and monographs for the period 1950-60 is presented. Only the latest edition of books published in several editions is listed. In a few cases, books published before 1950 are included, chiefly because they still serve as important reference works.

The bibliography is not intended to be exhaustive, though an effort was made to include most of the important and useful works published in the major Western languages. Russian publications are not included. However, translations of some important Russian works are listed.

The bibliography is classified according to the Universal Decimal Classification.

Tahal-Water Planning for Israel Ltd., Tel-Aviv, Israel.

McNeary, S. S., Remson, I., and Chen, H. S. C. HYDRAULICS OF WELLS IN UNCONFINED AQUIFERS. J. Hydraul. Div., ASCE 88 (HY 6): 115-123. Nov. 1962.

The differential equation describing unsteady radial flow to a well in an unconfined aquifer has no simple solution in terms of elementary functions because transmissibility decreases as the aquifer is dewatered. A numerical solution was achieved for an assumed relationship between transmissibility and head of water. Curves are presented showing the head of water in a homogeneous aquifer as a function of radial distance from the well and time elapsed after the water level in the well is lowered to and maintained at a given level. The curves are suitable for predicting water levels near such a well and for determining the hydraulic characteristics of unconfined aquifers from properly devised aquifer tests.

Drexel Inst. Tech., Philadelphia, Pa.



Hantush, M. S. HYDRAULICS OF GRAVITY WELLS IN SLOPING SANDS. J. Hydraul. Div., ASCE 88 (HY 4): 1-17. July 1962.

An approximate partial differential equation was developed for the flow of ground water through a water table aquifer resting on a sloping impermeable bed. The equation was integrated to obtain analytical expressions for the draw-down distribution around wells completely penetrating the water-bearing medium. The aquifer may be infinite in area or it may be bounded on one side by a fairly straight and effectively long section of a stream that cuts completely through the aquifer. The well may be operating at a constant head or at a constant discharge. The solutions are presented in forms amenable to relatively simple computation. The results are compared with those of a horizontally laid water-bearing medium.

N. Mex. Inst. Mining and Tech., Socorro, New Mex.

Ford, P. M. A STUDY OF HYDROMETEOROLOGICAL RELATIONSHIPS IN ALASKA. J. Geophysical Res. 67: 2411-2416, 1962.

An initial study of streamflow as a function of climatological factors in Alaska was described. A relationship between runoff and indices of temperature and precipitation was demonstrated in which the effects of the causal factors were interdependent. Formulas and curves were described for extending streamflow records and for forecasting seasonal runoff. Comparisons of estimated runoff with recorded runoff indicated close relationships between climatological and streamflow events. The interaction of the climatological factors was a distinguishing feature of hydrometeorological relationships in this region.

Bur. Reclam., U.S. Dept. Int., Denver, Colo.

Snyder, W. M. SOME POSSIBILITIES FOR MULTIVARIATE ANALYSIS IN HYDROLOGIC STUDIES. J. Geophysical Res. 67: 721-729. 1962.

The techniques of multivariate analysis were proposed for certain hydrologic applications where multiple regression produces unsatisfactory results. Equations evaluated by the method of least squares in multiple regression predict the dependent variable with minimum least-square error. No suggestions concerning the use of multiple regression for this desired end result were offered. Regression has also been used in hydrologic applications in which the numerical structure of the solution was of primary importance. The desired end result of this application was a reasonable numerical evaluation of the assumed model of the particular hydrologic processes under study. Multiple regression may produce unsatisfactory results in applications of the second kind. Comparative results of multiple regression and multivariate analysis for three applications were presented. First, the simple two-variable relationship was presented. Second, the improvement in establishing a relationship between rainfall and runoff was shown. Multivariate analysis produced a logical equation; multiple regression did not. Third, an application was shown in which the convergence to solution in the iterative technique of nonlinear least squares was improved.

Tributary Area Development, TVA, Knoxville, Tenn.



Peck, E. L. AN APPROACH TO THE DEVELOPMENT OF ISOHYETAL MAPS FOR MOUNTAINOUS AREAS. J. Geophysical Res. 67: 681-694. 1962.

A technique was developed in which anomalies from precipitation-elevation relationships were used in preparing isohyetal maps of Utah. October-April and May-September precipitation normals (averages for the 1921 to 1950 period) were computed for all available Utah precipitation records. The double-mass analysis technique was used in the derivation of the October-April normals, and for this purpose the State was separated into eight climatic divisions. Relationships between precipitation and water equivalent of snow cover at a network of 29 stations were used in estimating normal October-April precipitation for snow courses located above 8,000 feet. The May-September precipitation values for short-term stations were adjusted to the 1921-1950 period by the ratio method. The State was divided into 20 geographic zones, and for these zones it was found that good correlations existed between precipitation and station elevation for both the October-April and May-September periods. The precipitation-elevation relationships showed marked differences for some adjacent areas separated by high mountain ranges. From combined data for several zones, general precipitation-elevation curves for larger areas were obtained and departures of individual station normals from these curves were plotted on a contour base map. Analysis of these anomalies showed that the departures were related to physiographic features. Normal May-September and October-April values were determined for a grid of points over the State by using the anomaly pattern and general precipitation-elevation relationships. These values, together with the observed and adjusted normals, were used to locate the October-April and May-September isohyets. The large variations in normal precipitation due to topography were taken into account, yet the general precipitation-elevation relationships for small zones were retained. The accuracy of the isohyetal maps is considered comparable to that obtained by presently known methods, and the technique is less time consuming.

U.S. Weather Bur., U.S. Dept. Com., Honolulu, Hawaii.

Fayers, F. J., and Sheldon, J. W. THE USE OF A HIGH-SPEED DIGITAL COMPUTER IN THE STUDY OF THE HYDRODYNAMICS OF GEOLOGIC BASINS. J. Geophysical Res. 67: 2421-2431. 1962.

To predict the migration of hydrocarbons, and also to estimate water supply and water conservation requirements, it is important to be able to evaluate quantitatively the magnitude and direction of steady-state flows in aquifer systems and geologic basins. In many areas, sufficient information is available on topography, water tables, structure, stratigraphy, and permeabilities to make numerical solution possible on a digital computer. The equations governing steady-state flow are discussed, and the relevant aspects of the numerical analysis necessary for a proper solution are indicated. Results are given of the use of an experimental program applied to a three-dimensional model. A special algorithm for estimating the successive overrelaxation factor used in the numerical procedure is discussed.

Computer Usage Co., New York 21, N.Y.

Berry, J. L. SAMPLING, CODING, AND STORING FLOOD PLAIN DATA. U.S. Dept. Agr., Econ. Res. Serv. Agr. Hbk. 237, 27 pp. 1962.

Practical methods of sampling, coding, and storing data relating to the agricultural occupancy of flood plains in the United States were studied. The most efficient sample

for analysis of areal distributions, for making estimates of the areal coverage of phenomena, and for comparative analysis is a systematic, stratified, and unaligned point sample.

The systematic feature of such a sample facilitates an unconventional use of punched card systems that has the invaluable property of maintaining geographic ordering of the data. Once prepared, the punched cards provide permanent storage in a compact format. A nominal scale is used for coding. The card system with nominal coding and geographic ordering facilitates comparative analysis of land use, soil, slope, land capability, flood hazard, or other distributions by allowing easy preparation of contingency tables and rapid location of residuals in their geographic setting. Studies of changes through time are also facilitated.

Since the systems and operations are simple and readily applied, they can be undertaken directly in the field.

MOS, USDA, Inform. Div., Washington 25, D.C.

Reinhart, K. G., and Eschner, A. R. EFFECT ON STREAMFLOW OF FOUR DIFFERENT FOREST PRACTICES IN THE ALLEGHENY MOUNTAINS. J. Geophysical Res. 67: 2433-2445. 1962.

After a 6-year calibration, four watersheds in the Fernow experimental forest in West Virginia were logged during 1957-58. Practices ranged from a commercial clearcutting with "logger's choice" skid roads to a light selection cutting with planned skid roads on moderate grades. For the most part, the treatments did not seriously disturb the forest floor. Annual flow increased up to 5 area-inches on the clearcut watershed the year after treatment. Increases fell into a logical pattern with volume cut. Most of the increase came in the growing season. From May to October 1959, increases were 3.0, 1.8, 1.4, and 0.3 area-inches for per-acre cuts of 8.5, 4.2, 3.7, and 1.7 thousand board feet, respectively. Low flows were augmented, especially for the two heavily cut watersheds. Effect on high flows was variable; on the clearcut watershed some storm-period flows in the growing season were more than doubled, whereas some snowmelt flows were less than expected. Care in the logging operation was clearly reflected in water quality; maximum turbidities ranged from 56,000 p.p.m. on the watershed having unplanned skid roads and no provision for drainage to 25 p.p.m. on the watershed having carefully planned skid roads. Effects of treatment are diminishing with time.

Northwestern Forest Expt. Sta., FS, USDA, Parsons, W. Va.

West, A. J. SNOW EVAPORATION FROM A FORESTED WATERSHED IN THE CENTRAL SIERRA NEVADA. J. Forestry 60: 481-484. 1962.

The snowpack in the Sierra accounts for more than half of California's water, so any water loss reduces the amount of water available for irrigation, power, industry, recreation, and domestic use. A series of evaporation studies were conducted at the Central Sierra Snow Laboratory during the winters of 1958-60. Overall evaporation losses were a small percentage of total snowfall. Evaporation losses differed by size of forest openings, by density of the forest, and by slope and aspect.

Recent snow evaporation measurements from forest sites are summarized. Relationships of evaporation to forest and wind are discussed. Computed seasonal evaporation losses for a typical high Central Sierra small watershed are given.

Table 1.--Monthly Evaporation in a Small Forest Opening And In a Dense Forest (70 Percent Canopy Cover), Winters 1958, 1959, and 1960.

Month	1958		1959		1960	
	Forest	Opening	Forest	Opening	Forest	Opening
--Inches of Water--						
January .....	10.032	10.136	0.057	0.218	0.004	0.054
February .....	.017	.189	.009	.185	.138	.269
March .....	.048	.184	.509	.793	.182	.375
April.....	.358	.495	.352	.409	.131	.276
May .....	2-.028	.118	.022	.079	.083	.167
June.....	-.052	-.030	(3)	(3)	(4)	(4)
Total.....	0.375	0.992	0.949	1.684	0.538	1.141

<sup>1</sup> Average of 1959 and 1960 data.

<sup>2</sup> Minus indicates condensation.

<sup>3</sup> All snow gone by May 14, 1959.

<sup>4</sup> All snow gone by May 18, 1960.

Pacific Southwest Forest and Range Expt. Sta. FS, USDA, Berkeley, Calif.

Pillsbury, A. F., Pelishek, R. E., Osborn, J. F., and Szuszkiewicz, T. E. EFFECTS OF VEGETATION MANIPULATION ON THE DISPOSITION OF PRECIPITATION ON CHAPARRAL-COVERED WATERSHEDS. J. Geophysical Res. 67: 695-702. 1962.

Experiments were conducted during the period 1942-1959 in southwestern Riverside County, Calif., on the effects of vegetation manipulation of chaparral-covered watersheds on surface runoff and erosion. Small paired plots and one set of small paired watersheds were utilized. Conversion from a vegetative cover of brush to one of grasses and forbs increased surface runoff. This appears to be related primarily to the temporary detention of precipitation in the litter found under brush in this area. There was sometimes a marked increase in erosion during the conversion process.

U. Calif., Los Angeles, Calif.

Tackle, D. INFILTRATION IN A WESTERN LARCH--DOUGLAS-FIR STAND FOLLOWING CUTTING AND SLASH TREATMENT. Intermountain Forest and Range Expt. Sta. Res. Note 89, 7 pp. 1962.

Infiltration tests were made annually during a 5-year period in a mature western larch--Douglas-fir stand following timber harvest and slash treatment. These tests were made on soil showing four surface conditions: Tractor skid roads; scarified; broadcast burned; and undisturbed areas.

The first year after logging the infiltration capacity of skid roads, scarified areas, and broadcast burned surfaces averaged 4.1, 15.4, and 62.5 percent, respectively, of the capacity of undisturbed soil. During the succeeding 4 years the water intake capacity of scarified and lightly burned surfaces improved fairly rapidly, but the skid roads showed virtually no improvement.



Because both soil scarification and burning aid establishment of western larch and Douglas-fir reproduction, excessive soil compaction must not be permitted during slash treatment with heavy machinery. Impairment in water-absorbing capacity of the soil for long periods by compaction can lead to high runoff rates and soil erosion.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

## Geology

Ippen, A. T., and Drinker, P. A. BOUNDARY SHEAR STRESSES IN CURVED TRAPEZOIDAL CHANNELS. J. Hydraul. Div., ASCE 88 (HY 5): 143-180. Sept. 1962.

The flow patterns in the 60°-curved channel sections conform essentially to that of free-vortex flow, and superelevations can be computed accordingly. Boundary resistance causes trends to separation in the curved flow along the outside bank near the curve entrance and on the inside bank towards the curve exit. In addition to separation phenomena, the frictional effects lead to the expected helicoidal motion.

An investigation of flow through curves of trapezoidal channels resulted in the following conclusions:

1. The curved channel reaches were subject to shear stresses, which increased in intensity, as well as in areal extent, with conditions of increasing stream curvature. At large curvatures, the local stress maxima exceeded in intensity the normal mean shear for uniform motion in the approach channel by over 100 percent. The relative shear maximum was 2.4 in these tests.
2. The magnitude of the shear maxima produced by the curved flow is not predictable at present (1962) either by theory or from correlation to empirical coefficients of head loss for curves. It is possible to determine, from the measured shear patterns, the total head loss for the curve as well as the local average rates of loss throughout the curve on the basis of one-dimensional flow.
3. The locations of the shear maxima in the sections usually were associated with the course of the filament of highest velocity and with the zones of local accelerated motion. At large curvatures, high shear was found near the inside bank in the curve and near the outside bank below the curve exit; at lower curvature, the increased stresses appeared along the outer bank, in the downstream portion of the curve. Relatively high shears persisted for a considerable distance in the down-stream tangent reach.
4. For given channel alignments, the relative shear patterns were not greatly modified by variations in depth and velocity at the entrance section but depended primarily on the channel geometry.
5. The importance of boundary shear stress patterns with respect to the ultimate understanding of erosion and deposition processes in channel curves was demonstrated.
6. Although the orientation of the shear stresses was neglected in this study, it may assume considerable importance with respect to bank slope stability in channels through uniform noncohesive materials.
7. Additional studies are needed to evaluate the effects of central angle of curve, of boundary roughness, and of curve combinations, on the maximum shear rates and locations.

Mass. Inst. Tech., Cambridge, Mass.

Resistance to flow in an alluvial channel is extremely variable. The magnitude of the variations in terms of the Manning  $n$  may be as large as 300 percent because the roughness elements are formed by the interaction between flow, fluid, and sediment. The variation in resistance to flow, in addition to other factors such as scour or fill, may preclude obtaining a stage-discharge relation that is stable enough to be useful for some alluvial channels. A usable depth-discharge relation may be obtained, particularly the relation that occurs in the upper flow regime, if depth is used instead of stage and the changes in flow pattern and resistance to flow that occur with changes in the bed form are known.

The depth-discharge relations that result because of variation in resistance to flow fall into the following five categories: (1) The stream is always in the lower flow regime with a ripple or dune bed form, or both; (2) the stream is always in the upper flow regime with a plane bed, standing wave, or antidune bed form; (3) the flow regime of the stream changes from lower to upper or upper to lower with discharge; (4) the flow regime changes from lower to transition or transition to lower with discharge; and (5) the flow regime changes from transition with discharge.

The depth-discharge curve for the lower flow regime may loop and cross, or both, and will change from one runoff event to another. The depth-discharge relation for the upper flow regime is reasonably stable and changes little. Where the flow regime changes, the depth-discharge relation will have all the variation of the first category when in the lower flow regime; it may have a decided change in slope and even a discontinuity when flow regime changes; and it will have all the stability of the second category when in the upper flow regime.

The type and shape of depth-discharge curve for a given alluvial channel primarily depends on the following: Slope; variation in discharge; characteristics of the bed material, including fall velocity, which depends on the viscosity or apparent viscosity of the fluid; the rate of change of discharge with time; longitudinal and lateral variation in the bed material; depth and energy gradient; and, to a lesser extent, the effects of vegetation, wind, and seepage forces.

U.S. Geol. Survey., U.S. Dept. Int., Fort Collins, Colo.

Moore, W. L., and Masch, F. D., Jr. EXPERIMENTS ON THE SCOUR RESISTANCE OF COHESIVE SEDIMENTS. J. Geophysical Res. 67: 1437-1449. 1962.

Previous studies of the scour of cohesive materials are briefly reviewed. Exploratory tests for measuring scour resistance are described, and some correlated results are presented for a test involving scour by a vertical submerged jet impinging on the horizontal surface of a soil sample. The characteristics of the scour surface were observed for a remolded and a natural sediment, and the rates of scour were measured by the weight loss of the sample. The results are presented in terms of dimensional parameters. A new apparatus is described which is designed to permit a direct measurement of a uniform shear stress developed at the surface of a cylindrical sample of cohesive sediment.

U. Tex., Austin, Tex.

Dragoun, F. J. RAINFALL ENERGY AS RELATED TO SEDIMENT YIELD. J. Geophysical Res. 67: 1495-1501. 1962.

Data were obtained from two mixed-cover agricultural watersheds for an evaluation of the relationship of the kinetic energy of a rainstorm to suspended sediment yields. The relation is developed on the hypothesis that the cultivated acres are the only source of sediment. This statistical analysis is extended to cover the interaction effects of rainfall energy as a function of factors such as rainfall intensity and antecedent moisture. The results are examined and compared with the relationship of other factors of rainfall and watershed characteristics as a means of estimating sediment yields.

SWCRD, ARS, USDA, Hastings, Nebr.

Croft, A. R. SOME SEDIMENTATION PHENOMENA ALONG THE WASATCH MOUNTAIN FRONT. J. Geophysical Res. 67: 1511-1524. 1962.

Sediment from a small 2,100-acre drainage basin on the west face of the Wasatch Mountains in northern Utah, from the time of ancient Lake Bonneville of the Pleistocene epoch, to the present, is described. Major bodies of sediment consist of: (1) Silts and clays of lacustrine origin; (2) bouldery alluvium produced by mud-rock during the recession of the lake's waters to the present Great Salt Lake; and (3) bouldery alluvium produced by mud-rock flows of historic times that have been related to watershed abuse. An hypothesis, based on climatic and vegetal cover changes, is presented to explain the changes in pre-historic sediment production.

FS, USDA, Ogden, Utah.

Heinemann, H. G. VOLUME-WEIGHT OF RESERVOIR SEDIMENT. J. Hydraul. Div., ASCE 88 (HY 5): 181-197. Sept. 1962.

Sedimentation surveys of reservoirs should include information on the volume-weight of deposited sediment. This measurement provides a means of determining the sediment yield of a watershed and of applying the information gained from surveys to the solution of other sedimentation problems. Numerous factors may influence the volume-weight of sediment.

During the summer of 1960, a detailed study was made of the volume-weight of deposited sediment in Sabetha Lake, in Kansas, using a gamma probe and a piston-type sampler. The volume-weight of sediment in the lake varied from 35 to 92 lb. per cu. ft. The volume-weight primarily depended on the clay fraction of the sediment (smaller than 2 $\mu$ ) and, to a much smaller extent, on the depth of the sediment in a sediment deposit. The clay fraction tended to vary inversely with distance upstream from the dam. The sediment supplied by side tributaries altered this normal condition and caused the development of new, but similar, relationships.

SWCRD, ARS, USDA, Lincoln, Nebr.

Hantush, M. S. FLOW OF GROUND WATER IN SANDS OF NONUNIFORM THICKNESS: I. FLOW IN A WEDGE-SHAPED AQUIFER. J. Geophysical Res. 67: 703-709. 1962.

Formulas of ground-water flow through wedge-shaped aquifers were obtained for several flow systems of practical interest. It is assumed that the flow has no significant



component of velocity in the  $y$  direction so that its pattern is the same in all parallel vertical  $xz$  planes. The results are presented in terms of functions that are already available in tabular form, making these analytical expressions as easy to use as any other simple formula. These results show that the flow in wedge-shaped aquifers cannot be approximated by the flow in aquifers of uniform thickness (as currently practiced) except during very short periods which become longer for points closer to the source of the flow.

N. Mex. Inst. Mining and Tech., Socorro, N. Mex.

Hantush, M. S. FLOW OF GROUND WATER IN SANDS OF NONUNIFORM THICKNESS: II. APPROXIMATE THEORY. J. Geophysical Res. 67: 711-720. 1962.

Several flow problems in an aquifer whose thickness varies linearly or exponentially in the  $x$  direction while remaining uniform in the  $y$  direction are treated. Their solutions are based on a differential equation that has been set up to approximate the flow in such aquifers. Several initial and boundary conditions are considered. Some of the results are compared with those obtained in the first of this sequence of papers. It was concluded that the approximate solutions yield good results in sands confined by beds whose angles of dip have tangents less than 0.20. Also, the flow in wedge-shaped aquifers cannot be approximated by that which would exist if the aquifer were of uniform thickness except during very short periods which become longer for points closer to the source of flow.

N. Mex. Inst. Mining and Tech., Socorro, N. Mex.

Hantush, M. S. FLOW OF GROUND WATER IN SANDS OF NONUNIFORM THICKNESS: III. FLOW TO WELLS. J. Geophysical Res. 67: 1527-1534. 1962.

This is the third of a sequence of papers dealing with ground water flow in sands of nonuniform thickness. It is concerned with unsteady flow toward wells completely penetrating an aquifer whose thickness may be assumed to vary exponentially in the direction of  $y$  while remaining uniform in the  $x$  direction. The drawdown induced around a flowing well (well of constant head) or around a well that is pumped at a constant rate is obtained for aquifers that can be considered effectively infinite in areal extent. The flow toward steadily discharging wells near a fairly straight and an effectively long stream, or near an impermeable boundary which completely cuts through the aquifer, is also considered. The results are compared with those which would be obtained if the aquifer were of uniform thickness.

N. Mex. Inst. Mining and Tech., Socorro, N. Mex.

Luszczynski, N. J., and Swarzenski, W. V. FRESH AND SALTY GROUND WATER IN LONG ISLAND, N.Y. J. Hydraul. Div., ASCE 88 (HY 4): 173-194. July 1962.

The position and chloride concentrations of the fresh water and salty water bodies between Rockaway Park and Jones Beach in southwestern Long Island, N.Y., are described. Vertical components of the hydraulic gradients within and between fresh water and salty water bodies are defined.

Sizable reserves of fresh water are in the Lloyd sand member, especially in the eastern part of the project area where the aquifer is approximately 500 ft. thick. In the overlying

aquifers, significant quantities of fresh water are found only in the Magothy (?) formation, eastward from Lido Beach.

Salty water with chloride concentrations as high as from 10,000 to 16,000 p.p.m was found in permeable [Magothy (?) formation, Jameco gravel, and upper Pleistocene] but also in the clay deposits (20-ft. clay, Gardiners clay, and the clay member of the Raritan formation) underlying the barrier beaches in southwestern Long Island. The chloride content of the salty water in the clay member decreases with depth between Rockaway Park and Lido Beach. At Atlantic Beach, it decreases from approximately 16,000 p.p.m in the upper part to 110 p.p.m at the observation well screened in the lower part of the clay member. At Lido Beach, it decreases from 173 p.p.m in the upper part to 62 p.p.m at the observation well screened in the lower part of the clay member.

Isochlors in the Atlantic Beach-Lido Beach area delineate large bodies of salty water with chloride concentrations of less than 10,000 p.p.m, the desalinization of which may be economically feasible in the future.

Under present conditions, salty water in the clay member is moving downward very slowly at and near the supply wells screened in the Lloyd sand member; the rate of movement cannot be determined accurately. However, at Atlantic Beach and Lido Beach, further downward advance of salty water will be revealed by the increase in chloride content at the observation wells screened near the bottom of the clay member.

In the Long Beach area, the chloride content of salty water in the basal Magothy (?) and in the clay member is not known precisely. The chloride content of water in the upper part of the Lloyd sand member of the Raritan formation is also uncertain. The chloride content of water in these formations should be determined near well N-41 at the center of Long Beach through the use of multiple observation wells.

U.S. Geol. Survey, U.S. Dept. Int., Mineola, L.I., N.Y.

Schmidt, G. W., and Marsi, K. L. CHEMICAL ANALYSIS OF GROUND WATER RESOURCES OF ROOKS COUNTY, KANSAS. Kans. Acad. Sci. Trans. 64: 49-52. 1962.

Water samples from Rooks County obtained from five different sources--"Channel Alluvium", Alluvium, Ogallala formation, Niobrara and Carlile formations, and the Dakota formation were examined. The chemical composition of the water varied widely, not only among different geologic sources, but also among different locations in the same formation. Samples from the Ogallala formation and "Channel Alluvium" were chemically similar and generally less mineralized than those from the other three sources. Samples from the Niobrara and Carlile source and the Alluvium showed a chemical similarity, and generally were quite mineralized and hard. The water from the Dakota formation appeared to be the most highly mineralized water found.

Only 36 percent of the samples analyzed met all the general chemical requirements for acceptable drinking water as established by the U.S. Public Health Service Standards of 1946.

No address given.

## Engineering Design

Viessman, W., Jr., and Geyer, J. C. CHARACTERISTICS OF THE INLET HYDROGRAPH. J. Hydraul. Div., ASCE 88 (HY 5): 245-268. Sept. 1962.

The relationship between rainfall and runoff for an impervious inlet area was studied. Variables included antecedent rainfall, storm intensity and pattern, and size, shape, and

roughness of the inlet areas. Data for the analyses were derived from records of rainfall and runoff on impervious areas in Baltimore, Md., Newark, Del., and Hertfordshire, England. Equations for the determination of peak rates of runoff and time of rise of the hydrograph were developed, and a method was proposed for predicting the shape of a simple hydrograph.

The analyses reported constitute an initial step toward the use of rainfall records for the prediction of hydrographs that can, in turn, be the basis for routing storm water flows through drainage systems.

As more information is collected, the analyses will be improved and extended to cover partially pervious as well as impervious inlet areas. Attention will be directed toward prediction of runoff patterns during complex storms.

N. Mex. State U., University Park, N. Mex.

Bouwer, H. FIELD DETERMINATION OF HYDRAULIC CONDUCTIVITY ABOVE A WATER TABLE WITH THE DOUBLE-TUBE METHOD. Soil Sci. Soc. Amer. Proc. 26: 330-335. 1962.

Theory and principles of the double-tube method were applied and tested in laboratory and field studies. The former were carried out in a sandbox, where the hydraulic conductivity of 3.87 cm. per min. obtained with the double-tube principle agreed closely with the known conductivity of 4.10 cm. per min.

Field equipment and procedures for practical application of the double-tube method are discussed. A specially developed hole cleaner for obtaining an undisturbed soil surface at the bottom of the auger hole is described. It is shown how sufficient depth of saturation and corresponding consistency in resulting hydraulic conductivity values can be ascertained in the field without calculating the hydraulic conductivity after each set of measurements.

Results from the double-tube method in the field compared favorably with hydraulic conductivity data obtained in the laboratory from soil samples taken at the bottom of the auger hole after completion of the field tests. The double-tube method appears to be a suitable tool for in situ measurement of hydraulic conductivity of soil that is not saturated prior to the time of measurement.

SWCRD, ARS, USDA, Tempe, Ariz.

Getty, H. C., and McHughs, J. H. SYNTHETIC PEAK DISCHARGES FOR DESIGN CRITERIA. J. Hydraul. Div., ASCE 88 (HY 5): 1-12. Sept. 1962.

A method was presented for determining peak discharges at stations where records are too short to afford reliable data or at ungaged locations. The method is based on the two principal factors that create peak discharges: (1) The volume of surface runoff; and (2) the distribution of surface runoff. The data presented were compiled specifically for the hill areas of Arkansas and Missouri, but the methods followed may be applicable to other regions. The data are useful in determining discharges at bridges, culverts, dams, and other hydraulic structures, and for flood damage investigations.

Hydraul. Br., U.S. Army Engin. Dist., Little Rock, Ark.

Morgan, P. E., and Johnson, S. M. ANALYSIS OF SYNTHETIC UNIT-GRAPH METHODS. J. Hydraul. Div., ASCE 88 (HY 5): 199-220. Sept. 1962.

The basic unit-graph theory has been accepted as one of the best methods available for determining rainfall-runoff relationships from a drainage basin. Information derived from



this theory may be used to determine hydraulic flows to be used in the design of highway culverts, storm sewers, spillways, bridges, and flood protection structures.

To use the unit-graph theory, adequate rainfall and runoff records must be available to develop typical unit hydrographs for the basins involved. Most drainage basins have sufficient rainfall data available; however, stream-flow records are inadequate in most areas. To overcome this shortage of actual records, several synthetic methods have been proposed for developing unit graphs.

The relative accuracy with which four of these synthetic methods reproduce the actual unit graph for the basin was determined. The peak flow variations were from 198 percent above to 69 percent below the actual observed peak flows for 12 selected basins. It does not appear that any of the selected synthetic methods consistently overestimates or underestimates the actual peak discharge. Further study is necessary to determine the effect of errors in the synthetic unit graphs on the resulting design storm hydrograph.

Iowa State U., Ames, Iowa.

Smith, W., and Bailey, G. F. OPTICAL CURRENT METER. J. Hydraul. Div., ASCE 88 (HY 5): 13-22. Sept. 1962.

The optical current meter is a stroboscopic device developed to measure surface velocities of water in open channels without immersing equipment in the stream.

The meter is a light-weight battery-powered unit consisting of a low-power telescope, a set of rotating mirrors, a variable-speed drive motor, and a tachometer. Velocity measurements are made from an observation point above the stream by looking down at the water surface through the meter while gradually increasing the angular speed of the rotating mirrors. As synchronization is reached, the apparent motion of the water surface, seen through the eyepiece as a succession of frames or images, slows down and is finally stopped. The angular speed of the mirror wheel at this null point and the vertical distance from the optical axis of the meter to the water surface are the only factors needed to compute the velocity.

U.S. Geol. Survey., U.S. Dept. Int., Menlo Park, Calif.

Bouwer, H. ANALYZING GROUND-WATER MOUNDS BY RESISTANCE NETWORK. J. Irrig. and Drain. Div., ASCE 88 (IR 3): 15-36. Sept. 1962.

A technique for analyzing ground-water mound behavior under recharge or other source areas with a resistance network analog was presented. The principles of the technique are applicable to rising, stable, and falling mounds for two-dimensional or radial flow systems. The procedure enables the consideration of conditions of nonuniformity in soil conductivity, porosity, and recharge rates as well as complex geometry, boundary, and drainage conditions. Moving mounds are handled as a succession of stable mounds. The technique may be used in planning, designing, or analyzing actual installations, which requires adequate field data, or for studies of a general nature for which assumed values may be used.

Approximate equations are developed to predict the rate of rise or fall of the mound center above an original water table. Comparison of these equations with network analyses for two-dimensional rising mounds shows a good agreement if the width of the recharge area is less than four times the thickness of the originally saturated material.

Application of the horizontal-flow assumption and the associated use of the transmissibility coefficient in analytical treatment of ground-water mound behavior can lead to serious

errors. This assumption can overestimate or underestimate the rate of rise of a mound, depending on whether the original thickness of saturated material is relatively small or large, respectively. If the distance of the impermeable layer below an original water table exceeds the width or diameter of the recharge percolation zone, the flow system can be considered as of infinite vertical extent.

SWCRD, ARS, USDA, Tempe, Ariz.

Vimoke, B. S., and Taylor, G. S. SIMULATING WATER FLOW IN SOIL WITH AN ELECTRICAL RESISTANCE NETWORK. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-65, 51 pp. 1962.

Water infiltration, redistribution, and removal from soil are important processes that affect all land management systems. Although these processes must be studied under field and laboratory conditions, certain phases can be accurately evaluated by analog techniques with a considerable saving in time and cost. Two types of electrical analogs have been used with good success: (1) Those utilizing the flow of electricity through sheets of electrical conducting paper; and (2) those using a network of electrical resistors. Electrical conducting paper can be used to solve steady-state flow problems in porous media that are saturated, isotropic, and homogeneous with respect to its hydraulic conductivity. An electrical resistance network is more flexible in its use than conducting paper. The network can be adjusted quickly to simulate flow conditions in soils that are homogeneous or stratified, saturated or unsaturated, isotropic or anisotropic.

A method for calculating and assembling network resistances to represent water flow in soil was presented. The approach used is called the "building block" method. The soil profile is considered to be composed of discrete, rectangular blocks of soil. These blocks are then joined to "build" the entire soil profile. Each block of soil is represented by a mesh of four resistors. The meshes are then joined to form the network, which, in turn, represents the soil profile. The discussion deals with representations of steady-state flow of fluid in saturated and unsaturated media. Procedures are given for representing media that are either homogeneous or stratified and either isotropic or anisotropic with respect to soil hydraulic conductivity. Formulas are given for calculating resistances when rectangular blocks of different dimensions are used. Special formulas are presented for calculating resistances adjacent to a tubular drain embedded in the soil.

ARS, USDA, Inform. Div., Washington 25, D.C.

## Ground Water Recharge

Valliant, J. C. ARTIFICIAL RECHARGE OF SURFACE WATER TO THE OGALLALA FORMATION IN THE HIGH PLAINS OF TEXAS. High Plains Res. Found. B. 1, 17 pp. 1962.

Recharge studies and operations conducted from June 1959 to June 1962 showed that artificial recharge of ground water through properly installed and maintained wells is a practical means of replenishing the underground water source in the High Plains of Texas.

During the 3-year period 1959-62, 257 acre-feet of water were recharged into the formation through the research well. In May of 1961, another recharge well was installed at the Foundation and by June 1962, 68 acre-feet of water were recharged through this well.

The total of 325 acre-feet of water recharged is 32 percent of the total amount pumped on the entire farm over the same time.

The pumping capacity of the research well has been maintained at 1,000 gallons per minute over the 3-year period. Pumping of large quantities of sand has been stopped by maintaining the 850-gallon-per-minute recharge rate.

In July 1960, 12 inches of rain filled the lake at the research well to a 110 acre-foot capacity. Of this amount, 80 acre-feet were recharged and 30 acre-feet were lost through evaporation and deep percolation. Core samples taken by the U.S. Geological Survey showed little or no deep percolation past a depth of 30 feet in the lake bottom. Most of the 30 acre-foot loss was due to evaporation. Through recharge, a higher amount of evaporation was prevented. On most of the lakes in the High Plains, natural recharge to the underground formation is less than 10 percent of the total amount caught in the lake.

INSTALLATION. The following four things are necessary in the installation of a recharge well if it is to function properly: (1) A concrete packer around the top 30 to 35 feet of casing; (2) perforation of the casing beginning at the static water level; (3) installation of a vent pipe through the concrete packer; and (4) installation of an intake control valve.

OPERATING PROCEDURE. The greatest hazard in recharging the underground formation with raw lake water is clogging. Pumping the well 1 1/2 to 2 hours during each 24-hour recharge period has prevented this. Such pumping removes a large percentage of the solids which are carried into the well. Surging (stopping the pump to permit the column of water in the pump to drop back into the well) every 15 minutes facilitates removal of the solids by keeping them in suspension. Where this pumping and surging procedure has been followed, there has been no reduction in pumping or recharge rates over the 3-year period.

A valve should be installed in the intake line between the well and the lake so that the rate of recharge can be controlled at all times. Rate of recharge is the main controlling factor in recharge of raw lake water.

Chlorinating or sanitizing the well is recommended to prevent bacterial growths and control contamination.

High Plains Res. Found., Halfway, Tex.

Hantush, M. S., and Papadopoulos, I. S. FLOW OF GROUND WATER TO COLLECTOR WELLS. J. Hydraul. Div., ASCE 88 (HY 5): 221-244. Sept. 1962.

Horizontal wells, generally known as collector wells, have been used under favorable hydrogeological conditions as a means for ground-water recovery. They have been reported to yield large quantities of water when located adjacent to streams, or in permeable aquifers removed from surface-water supplies.

Analytical solutions for the drawdown distribution around collector wells steadily discharging from homogeneous confined and unconfined aquifers of uniform hydraulic properties are presented. It is assumed that the aquifer is horizontal and uniform in thickness; the radius of each of the laterals of the collector well is small compared to the thickness of the aquifer; the radius of the caisson is small compared to the length of the lateral; and the yield of each of the laterals is uniformly distributed along its length. Relatively simple equations for the yield of collector wells located near, or under, stream channels also were obtained. Drawdown distributions around collector wells of symmetrically located laterals in a relatively thick aquifer are graphically illustrated. Profiles of drawdown induced by collector wells in completely penetrating observation wells were shown.

New Mex. Inst. Mining and Tech., Socorro, N. Mex.



Barton, L. INDUSTRIAL WASTE SPRINKLER SYSTEMS. Irrig. Engin. and Maintenance. 12(4): 14-16. 1962.

When an industrial plant is given notice to cease dumping its polluted effluent into public waters, it is usually given a deadline, at least 2 years in advance. It must make one of the following choices: (1) Construct a conventional treatment plant, which is very expensive both in first cost and in operation, particularly in the case of a plant which operates only seasonally; (2) move to another region; (3) go out of business; or (4) find some other disposal scheme, such as lagooning and/or broadfield irrigation either by sprinkling or the trickling method.

Lagooning is sometimes good, but, because of odors, lack of suitable location, and sheer volume it is often impossible. The capacity of a lagoon is about 200 pounds of BOD (Biochemical oxygen demand) material per acre per day. Thus, each acre of lagoon will digest about 12,000 gallons per day of waste containing 2,000 parts per million of BOD.

Sprinkler systems are not merely large-scale filtration plants using woods, agricultural, or wasteland as the filter bed. Filtration is important in greater or lesser degree as the soil is more or less permeable, but the purification really takes place as the result of complicated but well-understood natural processes at or just below the surface of the soil. When water containing organic impurities is spread over a land surface, the organic molecules are absorbed on particles of soil and humus at or near the surface, thus removing them from solution or suspension. The organic material in the waste water is then oxidized by the combined action of bacteria, actinomycetes, molds, protozoa, and, to some extent, enzymatic action of the roots of the plant cover.

The presence of large quantities of plant materials, dead or alive, greatly increases the efficiency of the process. Properly managed, a disposal area will improve during its years of use. Conversely, poor management can ruin an area. Overwatering causes gullying and excess polluted water escapes.

The use of woodland is often very desirable, but a suitable disposal area can be developed on open fields. Cultivated land is unsatisfactory for waste purification until a good vegetative cover has been developed. Once a deep layer of humus, decaying organic material, living grasses, and other plants has been developed, the capacity of an area to purify waste water will increase.

Lewis W. Barton Co., Haddonfield, N.J.

## WATERSHED MANAGEMENT

### Irrigation

Madison, J. H., and Hagan, R. M. EXTRACTION OF SOIL MOISTURE BY MERION BLUEGRASS (POA PRATENSIS L. MERION) TURF, AS AFFECTED BY IRRIGATION FREQUENCY, MOWING HEIGHT, AND OTHER CULTURAL OPERATIONS. Agron. J. 54: 157-160. 1962.

A well-established, high-quality turf of Merion bluegrass was subjected to 3 heights of cut, 3 irrigation frequencies, 2 "cultivation" treatments, and 2 replications for a 2-year period. Irrigations were discontinued in late September and soil moisture determinations were then made every second or third day at depths up to 36 inches.

Water extraction by 3- and 4-year-old Merion bluegrass sod occurred almost entirely in the top 20 inches of the soil.

Height of cut, irrigation frequency, and aeration treatments all produced significant differences in water extraction. Soil water extraction per plant was directly proportional to the height of mowing. Frequent irrigation resulted in sparser and shallower rooting, and smaller differences in rooting caused by height of cut.

Population studies showed that treatments produced population differences.

In contrast to pasture studies, yields of turfgrass do not directly express the effects of treatments. The amount of plant surviving beneath the cutter bar may be more pertinent information.

Cultivation treatments produced a small but consistent increase in the extent of rooting.

U. Calif., Davis, Calif.

Epstein, E., Grant, W. J., and Hardesty, J. S. SOIL MOISTURE SURVEY OF SOME REPRESENTATIVE MAINE SOIL TYPES. U.S. Dept. Agr., Agr. Res. Serv. ARS. 41-57, 57 pp. 1962.

Recent increases in irrigation practices in the humid region have fostered a greater interest in the determination of the available water-holding capacity of soils.

Selection of soils was based on their importance as an agricultural soil and on the need for moisture retention information in regard to irrigation practices. The soils studied were listed in table form with the available moisture to a 30-inch depth. All samples were taken from cultivated land, and the profiles were described by soil scientists of the Soil Conservation Service. Soil type descriptions were presented in tables at the end of the report.

Tables, profile descriptions, and maps.

ARS, USDA, Inform. Div., Washington, D.C.

Machmeier, R. E., and Allred, E. R. WATER DISTRIBUTION WITH BOOM SPRINKLERS. Irrig. Engin. and Maintenance 12(5): 13, 16-17. 1962.

The practical aspects of boom sprinklers, which are becoming increasingly popular in the upper midwest area of Minnesota, Wisconsin, and the Dakotas were studied.

The pattern of precipitation from a boom sprinkler was quite unlike that from the conventional rotating sprinkler head. Triangular or staggered spacings gave the most uniform precipitation.

The distribution of water by a boom sprinkler was affected by wind speed, which distorted the pattern of the water after it was discharged from the nozzle and caused a non-uniform speed of rotation of the sprinkler. Wind drag forces, acting on the boom arms, created an unbalance of forces which caused the rotational speed to vary throughout each revolution of the sprinkler. Those sectors of the wetted circle where slower speeds prevailed received greater amounts of water than other sectors. To obtain maximum uniformity of distribution, the rotational speed should remain as nearly constant as possible.

Rotational speed affected the distance that water was discharged from the end nozzles of the boom sprinkler. The wetted diameter decreased as the sprinkler rotated at higher speeds. At such speeds, the end nozzles moved through the air at a higher velocity, causing early breakup of the stream near the nozzle with a resulting loss of distance. While the decrease in the wetted diameter may have some adverse effect on the overlap of adjacent sprinkler settings, the break-up of the water may improve the distribution pattern within the area covered by the sprinkler.

One benefit of an early break-up of the stream as it leaves the nozzles rotating at higher speeds is the more effective distribution at lower operating pressures. It is possible to obtain good distribution patterns with relatively low pressures at a sacrifice of some distance in wetted diameter. While it is desirable to have a maximum sprinkler spacing, it is more essential to attain a good distribution pattern within the area covered by the sprinkler. Some adjustment of these factors under the various wind conditions was necessary to obtain the maximum irrigation efficiency.

Most boom sprinklers rotate as a result of the jet reactive forces produced by the discharging nozzles. The rotational speed is dependent upon the relative magnitude of the total reactive force and the total force resisting rotation.

U. Minn., St. Paul, Minn.

Kruse, E. G., Schleusener, P. E., Selby, W. E., and Somerhalder, B. R. SPRINKLER AND FURROW IRRIGATION EFFICIENCIES; EITHER METHOD CAN BE DONE EFFICIENTLY. Agr. Engin. 43: 636-639, 647. 1962.

Efficiencies of sprinkler and furrow irrigation were compared under conditions suitable for irrigation by either method. Sprinklers applied water with an average application efficiency of 82.5 percent. The average application efficiency obtained with furrow irrigation was significantly lower, 74.4 percent. This difference in application efficiency required the application of 1.1 in. more irrigation water each year on the furrow-irrigated plots than on the sprinkler-irrigated plots.

Water-distribution efficiencies averaged 2.3 percent higher for the sprinkler method than for the furrow method. The cumulative effects of several irrigations will raise water distribution efficiencies of either irrigation method on a seasonal basis. High water-storage efficiencies were obtained with both methods.

Differences in yield of grain sorghum between the sprinkler- and furrow-irrigated plots were not significant at the 5-percent level of probability.

The studies showed that with proper design and operation both sprinkler and furrow methods will supply water to the root zone at a high level of efficiency.

SWCRD, ARS, USDA, Fort Collins, Colo.

Tovey, R. A PORTABLE IRRIGATION SPRINKLER EVALUATION DEVICE. Irrig. Engin. and Maintenance. 12(2): 8-9. 1962.

Sprinkler irrigation is an integral part of modern agriculture. The design of sprinkler irrigation systems requires a sound knowledge of engineering and agricultural principles. Each area, farm, or field presents individual problems that must be analyzed and considered in designing an efficient system. The portable sprinkler evaluation device offers a simple and practical means for the field evaluation of soil intake rate, sprinkler application rate, lateral spacing, and other factors that influence the design of sprinkler irrigation systems.

This portable sprinkler evaluation device consists of a trailer-mounted recirculating unit with the sprinkler head operating inside a circular shield.

The trailer-mounted recirculation unit consists of a 1-ton capacity trailer, a 300-gallon water supply tank, two self-priming centrifugal pumps (one with sufficient capacity to deliver at least 45 g.p.m. at 80 p.s.i. to the sprinkler nozzles, and the other capable of returning all excess water from the shield to the supply tank), flexible intake and discharge hose for



both pumps, a pressure gage, and four control valves. The screened intake hose and valve arrangement for the main pump makes it possible to operate the sprinkler device directly from irrigation canals or ditches, or it can be used to fill the water supply tank.

SWCRD, ARS, USDA, Reno, Nevada.

Cooper, C. S., Klages, M. G., and Schulz-Schaeffer, J. PERFORMANCES OF SIX GRASS SPECIES UNDER DIFFERENT IRRIGATION AND NITROGEN TREATMENTS. *Agron. J.* 54: 283-288. 1962.

The responses of 2 sod-forming pasture grass species, 2 bunch-type pasture grass species, a wetland species, and a dryland species to 4 irrigation and 5 nitrogen treatments were measured over a 3-year period. Species were harvested by clipping at 28-day intervals to simulate pasturing. Herbage yields of all species for all treatments, and crude protein content and percentage recovery of applied N of 2 species for selected treatments were determined.

Responses of species to irrigation were similar, except for orchardgrass, which in 1959 was adversely affected by low irrigation levels and consequently showed a greater yield response to irrigation than other species.

Responses to N varied among species. Species generally rated as most productive responded most to high application of N with the exception of orchardgrass, which responded relatively less than other species, particularly when grown under low irrigation. Nitrogen applied at 50 and 100 pounds per acre resulted in yield increases only in early season, but 200 or 400 pounds of N per acre increased yields throughout the season. Neither N application nor irrigation influenced the characteristic yield decline of species in mid- and late-summer.

Species decreased more in yield as stands aged at low than at high levels of irrigation and N application. The extent of yield decline varied among species.

Crude protein content of herbage of smooth brome grass was consistently higher than that of orchardgrass. Crude protein content of herbage was increased only in early season with an application of 100 pounds of N per acre, but was increased throughout the season with an application of 400 pounds of N per acre.

Percentages of applied N recovered increased with increasing frequency of irrigation and were greater on plots fertilized with 100 pounds of N per acre than on plots fertilized with 400 pounds of N per acre.

CRD, ARS, USDA, Mont. Agr. Expt., Sta., Bozeman, Mont.

Maas, E. F., Webster, G. R., Garnder, E. H., and Turley, R. H. YIELD RESPONSE, RESIDUAL NITROGEN AND CLOVER CONTENT OF AN IRRIGATED GRASS-CLOVER PASTURE AS AFFECTED BY VARIOUS RATES AND FREQUENCIES OF NITROGEN APPLICATION. *Agron. J.* 54: 212-214. 1962.

Annual spring applications of 60-52-50 pounds of N-P-K per acre were made to an irrigated grass-clover pasture. The application of 75, 150, and 225 pounds of additional N per acre during the summer increased the total yield of forage by 827, 1,392, and 1,658 pounds of dry matter per acre, respectively. No appreciable differences in total yield were obtained by splitting the same rates into 2, 3, or 5 applications.

The percentage clover in the grass-clover mixture was reduced from 23 percent in the check to 16 percent in the 75-pound per acre N treatment and further decreased with heavier N applications. Frequency of application had little effect on the clover stand.

The yield response to applied N occurred mainly within the first month following application. Residual effects of N were small in the second month following a spring N application but were larger following later applications, indicating a need for heavier N applications in the spring than later in the season. Because of the rapidity of response to N and the limited residual effect, monthly N applications gave a more uniform yield increase for each clip throughout the season than did bimonthly applications.

The percentage nitrogen in the forage increased in the clip following an N application, but the average N level for the six clips taken during the season increased with the total amount of N applied and was not affected by the frequency of N application.

Canada Dept. Agr. Res. Br., Expt. Farm, Saanichton, British Columbia, Canada.

Lathwell, D. J., and Vittum, M. T. RESPONSE OF ALFALFA TO IRRIGATION AND FERTILITY LEVEL. *Agron. J.* 54: 195-198. 1962.

In 5 of 8 years when other factors were not limiting, irrigation on a silt loam soil in a vegetable crop rotation including alfalfa significantly increased dry matter yield of alfalfa by 1,490 pounds per acre per year. Extra fertilizer increased total yield by 240 pounds of dry matter per acre per year. Highest yields, averaging 10,500 pounds of dry matter per acre per year, came from irrigated, high-fertility-level plots.

Cornell U. Agr. Expt. Sta., Ithaca, N.Y.

Robins, J. S., and Domingo, C. E. MOISTURE AND NITROGEN EFFECTS ON IRRIGATED SPRING WHEAT. *Agron. J.* 54: 135-138. 1962.

Yield depressions of 10 to 35 percent in irrigated spring wheat resulted from severe moisture stress. Reductions were greatest when moisture stress was imposed during and following heading or during maturation. Severe moisture stress before heading reduced the yield nearly 30 percent in 1957 but had no measurable effect in 1955.

Grain and vegetative yield responses to nitrogen were obtained only in 1957. The grain yield increase was due largely to increased head population. No yield interaction between moisture and nitrogen was observed. Susceptibility to lodging was greatly increased by application of nitrogen.

Moisture stress prior to heading resulted in marked second growth which in both 1955 and 1957 increased head population but delayed the date of maturity. Moisture stress during and following heading generally resulted in fewer heads, fewer spikelets per spike, and fewer kernels per spikelet. Head and kernel populations were generally lowered by moisture stress late in the development of the plant. Kernel weight was greatly reduced by moisture stress prior to maturity; otherwise it was closely related to kernel population. Plant height at harvest was depressed by moisture stress prior to and during heading.

There appeared to be no benefit from irrigation of spring wheat prior to the boot stage of development unless moisture stress as indicated by wilting or curling of the leaves was observed. Severe moisture deficits should be avoided from the boot stage until the grain is mature. In particular, depletion of all available moisture prior to maturity should be avoided.

SWCRD, ARS, USDA, Boise, Idaho.

Jensen, M. E., and Musick, J. T. IRRIGATING GRAIN SORGHUMS. U.S. Dept. Agr. L. 511, 6 pp. 1962.

Irrigation may greatly increase the value of rainfall for sorghum grain production. In areas where rainfall is not adequate for good yields, most of the moisture produces vegetative growth. To produce the first increment of grain, 8 to 11 inches of water are required. By the time grain development begins, rainfall may not be adequate to mature the crop. A well-timed irrigation in the southern Great Plains has resulted in more than 500 pounds of grain per acre-inch of water stored in the soil. In nonirrigated areas, yields of grain vary from 0 to 200 pounds per acre-inch of rainfall.

Irrigation systems should not be set up unless the increased income will exceed the additional costs involved. Dryland management practices, using wide rows and low seeding rates, may be more efficient in some areas.

ARS, USDA, Inform Div., Washington 25, D.C.

Colville, W. L., and McGill, D. P. EFFECT OF RATE AND METHOD OF PLANTING ON SEVERAL PLANT CHARACTERS AND YIELD OF IRRIGATED CORN. Agron. J. 54: 235-238. 1962.

Studies of plant population and method of planting irrigated corn were conducted over a 5-year period at 7 locations in Nebraska.

Grain yields were influenced by both plant population per acre and by the method of planting. Interactions between populations and method of planting were not found in either the single experiment or combined statistical analysis. Little difference was noted between yields from populations of 16,000, 20,000, and 24,000 plants per acre. Further population increases over 24,000 plants per acre generally resulted in decreased yields.

Drilled corn was definitely superior in yield to both hill-dropped and checked corn in these experiments. Individual experiment averages show that drilling increased yields by 22.4 to 9.8 bushels per acre over checked corn. Long term means show that irrigated corn can be drilled at 24,000 plants per acre or 4,000 plants greater than checked corn without yield decreases.

Certain disadvantages occurred with increased plant population. Lodged and broken plants, kernel moisture, and ear height increased as populations were increased. The lack of the mutual support found in checked or hill-dropped corn and the presentation of a more solid barrier of taller corn to the wind may account for the increased stalk lodging and broken plants despite the greater stalk diameter found in drilled populations.

Despite these characteristics, drilled corn consistently outyielded checked and hill-dropped corn populations. Hill-dropped also outyielded checked corn. With increased use of drying equipment and picker shellers, allowing early picking, it is doubtful that lodging, breaking, and ear drop losses would often exceed the added yield increment found in drilling irrigated corn.

U. Nebr., Lincoln, Nebr.

Somerhalder, B. R. DESIGN CRITERIA FOR IRRIGATING CORN. Agr. Engin. 43: 336-339, 348. 1962.

Measurements of consumptive use of water for corn grown on silt loam soils at North Platte, Nebr., were made from 1956-58. Water regimes varied from no irrigation after planting to irrigation as required to maintain limited soil moisture tension from planting to maturity. All plots were preirrigated as required to fill the soil to field capacity to a depth



of 6 ft. before planting. Intermediate treatments involved time of irrigation (as related to plant development and rotation delivery water schedules) and quantities computed by an empirical equation based on daily mean temperature and daily mean percentage of annual daylight hours. The authors concluded that:

1. Accumulative water use under limited soil moisture tension established the pattern of water use for cropping period.
2. Consumptive-use requirements were fulfilled by irrigation computed on the basis of the daily use calculated by the empirical equation tested.
3. Mean daily use for 10-day periods commencing at the planting date formed curves with characteristics common to all years. Rates began at 0.1 inch per day or less in May and increased to a maximum during the last 10 days of July, then declined to 0.1 inch and less by late September.
4. Peak water-use rates as high as 0.36 in. per day for 10 days occurred just before the pollination stage of the plant. Approximately two-thirds of the total water use for a cropping period occurred by the early milk stage of the ear.
5. Three irrigations centered on the pollination stage produced yields comparable to limited soil moisture tension to maturity. Three irrigations applied on a 14-day rotation water-delivery schedule produced similar yields.
6. One irrigation in July at the pretassel stage produced yields equal to 94 percent of the yield of the limited soil moisture tension treatment.
7. The relationship between corn yield and total water used is not a constant. Diminished production per unit of water results not only when the water supply is less than crop needs but also when the supply exceeds the water storage capacity of the soil in the root zone.

U. Nebr., Lincoln, Nebr.

Schreiber, H. A., Stanberry, C. O., and Tucker H. IRRIGATION AND NITROGEN EFFECTS ON SWEET CORN ROW NUMBERS AT VARIOUS GROWTH STAGES. Sci. 135(3509): 1135-1136. March 30, 1962.

An investigation was conducted on Superstition lfs at Yuma, Ariz., in 1959 as part of a much larger 3-year study, 1957-1959. Certified Golden Cross Bantam sweet corn (Zea mays L.) was grown to determine the effect of quantity and timing of irrigation and nitrogen on several basic components of yield ears per plant, rows per ear, kernels per row, and weight of individual kernels.

Both genetic constitution and environment play a role in the expression of the sweet corn row numbers. Although probably affected predominantly by genetic factors, results presented provide strong evidence that row numbers also were increased by cultural practices, specifically that rows per ear were determined within the stage of establishment, before the plants were 8 inches tall. When the nitrogen application effects were subdivided into individual degrees of freedom, highly significant effects were noted for rate of N over all applications and for application at planting for either rate, with no subsequent effect of N on kernel row numbers for subsequent times of application. In fact, 80 percent of the variation for nitrogen was directly attributable to the effect of N application in the planting stage. Of the 1,800 individual ears examined, all had an even number, varying from 8 to 16. Row numbers appeared to be unaffected by the irrigation levels used, and to be increased

by N only in the first stage of growth. Supplemental N at rates to 100 lb. per acre during plant establishment resulted in further increases.

Although row number is considered a component of yield, and was increased by supplemental N, yields were not increased. Apparently this was because fewer rows per ear led to compensating increases in individual kernel number and size.

SWCRD, ARS, USDA, Tucson, Ariz.

Morris, J. R., Kattan, A. A., and Arrington, E. H. RESPONSE OF ELBERTA PEACHES TO THE INTERACTIVE EFFECTS OF IRRIGATION, PRUNING, AND THINNING. Proc. Amer. Soc. for Hort. Sci. 80: 177-189. 1962.

The interactive effects of irrigation, pruning, and thinning on yield, growth, quality, and foliar mineral content of Elberta peaches were studied. In Arkansas, this variety ripens during the latter part of July, when available soil moisture is frequently low, which consequently restricts fruit growth during final swell.

Fruit load should be determined according to irrigation practice and control of fruit load should be accomplished by fruit thinning rather than by pruning. Without supplemental irrigation, marketable size (minimum diameter of 2 inches) can be assured only by reducing the fruit load by severe pruning and thinning to 6-7 inches between fruits. With irrigation, increasing the fruit load by thinning to 2-3 inches between fruits gave the highest marketable yields. No significant difference was obtained between all-season irrigation and irrigating only during final-swell. However, production of fancy-size fruits with minimum diameter of 2½ inches was materially increased only by a combination of all-season irrigation, severe pruning, and thinning to 6-7 inches between fruits.

Terminal growth was enhanced by all-season irrigation and severe pruning. The foliar contents of N, P, K, and Ca were affected by the variables under study, however, K was the most responsive and increased sharply with all-season irrigation and severe pruning.

Titrateable acidity of the raw product increased with all-season irrigation, severe pruning, and heavy thinning. Percentage of soluble solids increased with lighter fruit loads, and decreased with irrigation. Severe pruning also resulted in best flesh color (Hunter a:b ratio). After storage for 2 days at 70° F., fruit produced by a combination of final-swell irrigation and light pruning was the least firm. Evaluation of the canned product, indicated that both taste and color were improved by irrigation and severe pruning.

U. Ark., Fayetteville, Ark.

Code, W. E. GROUND WATER AND THE BIJOU VALLEY. Colo. Agr. Expt. Sta. B. 512S, 21 pp. 1962.

Pumping for irrigation within the arbitrary study area in Bijou Valley began in 1935. Within this area of 53,750 acres, 173 operating irrigation wells were serving some 15,500 acres of croplands in 1956.

Initially, there was a small annual decline of the water table. But beginning about 1949, the decline accelerated in much of the area, reaching the rate of about 1½ feet each year. The saturated thickness of the sands and gravels at the beginning of pumping varied from 80 feet at the south end to 150 feet at the north end of the study area. A large proportion of well capacity already has been lost. Well depth is strictly limited by thick shale deposits and no improvement in capacity is possible by deepening.

Water is being withdrawn from storage continually under present conditions. Replenishment from flood flows in Bijou Creek occurs in substantial amounts very infrequently and the downward trend of the water table is expected to continue. The yield of wells will continue to decline and abandonment will occur progressively.

Because abandonment will slow the rate of water-table decline, the present rate cannot be projected far into the future. Within 15 or 20 years, half or more of the area now irrigated may be back to dry farming. Such change would have a severe effect on the economy of the community.

Colo. State U., Agr. Expt. Sta., Fort Collins, Colo.

## Drainage

Swartzendruber, D. APPROXIMATE WATER FLOW RATES FOR TUBE DRAINS IN STRATIFIED SOILS. J. Geophysical Res. 67: 2395-2402. 1962.

A general theoretical method of approximating the steady-state, two-dimensional seepage rate in stratified porous media was applied to tube drainage in layered soils. The approximation was obtained by considering the layered system in three special, mathematically degenerate cases for which theoretical and practical information was often available. For drain tubes in a surface soil layer of given permeability overlying an infinitely deep layer of a different permeability, the approximate flow rate was within 8 percent of the exact flow rate. When the drain tubes were in a more permeable layer that was sandwiched between two layers of less permeable material, the approximate result was always within 25 percent of the value obtained with a resistance network. The approximate method is a relatively simple approach which appears to have promise for a variety of flow problems. It should also find utility as a check for flow solutions obtained by other means.

Purdue U., Lafayette, Ind.

Kunkle, G. R. THE BASE-DURATION CURVE, A TECHNIQUE FOR THE STUDY OF GROUNDWATER DISCHARGE FROM A DRAINAGE BASIN. J. Geophysical Res. 67: 1543-1554. 1962.

The baseflow-duration curve provides a technique for the comparative study of base runoff from the same or different drainage basins. The curve is a cumulative frequency curve showing the percentage of time that specified base flows were equaled or exceeded during a given time period. Daily base flows are obtained from a hydrograph separation of base and surface runoff. Although the separation may not be precise, the value of the technique as a comparative tool is not lost as long as a consistent method of separation is followed. When bank storage is present within a basin, the base runoff can be separated on the hydrograph into two components, designated bank- and basin-storage discharge. These are differentiated on the baseflow-duration curve by the shape of the curve. The baseflow-duration curve allows comparisons of total base runoff and the base runoff components. Examples illustrating the use of the technique show that: (1) The texture of the surficial deposits largely controls the discharge from basin storage; (2) the width of the permeable deposits adjacent to the river greatly influences the amount of bank storage discharged; (3) the mean annual amount and variation of bank storage may be several times that of basin storage; and (4) one typical water year provides enough hydrologic data for a valid comparative study of base runoff from segments of the same drainage basin.

Res. Council Alberta, Edmonton, Alberta, Canada.



Diamond, R. B., Hammond, L. C., and Myers, J. M. DRAINAGE CHARACTERISTICS OF LEON AND FELDA SANDS: I. WATER TABLE BEHAVIOR. Soil Crop Soc. Fla. Proc. 21: 38-44. 1961.

Drainage plots with variable-spaced open ditches were established on Leon and Felda sands. The influences of soil type, physical properties of the soil profile, and ditch spacings on the behavior of the water table during drainage and subirrigation were investigated. The falling water tables were elliptical in the Leon and flat in the Felda. There was a highly permeable shell layer under the slowly permeable sandy loam layer in the Felda in contrast to a slowly permeable layer underlying the Leon. Ditch spacings tended to influence water outflow and inflow very little on the Felda, but to a marked degree on the Leon. During subirrigation, the sandy loam layer in the Felda was penetrated only slightly during 13 days under a head of 1.5 feet of water. The organic pan in the Leon was more readily penetrated by the upward moving water table.

Where close control of the water table is desirable, ditches on Leon soil should be spaced approximately 133 feet. On Felda soil underlain by permeable shell or gravel, deep ditches spaced 405 feet or more should be adequate for subsurface drainage. Provision for surface drainage is desirable on Leon soil and absolutely necessary on Felda soil for satisfactory water control.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Brown, J., Grant, C. L., Ugolini, F. C., and Tedrow, J. C. F. MINERAL COMPOSITION OF SOME DRAINAGE WATERS FROM ARCTIC ALASKA. J. Geophysical Res. 67: 2447-2453. 1962.

Columns of synthetic ion-exchange resin were used to sample the exchangeable cations in drainage waters of northern Alaska. Details of the sampling and analytical procedures were presented. For the elements Na, K, Mg, Ca, Sr, and Ba, an average recovery of 96 percent was realized on a typical sample. However, recoveries were quite low for most trace elements. Sampling was necessarily diversified, but results for major cations closely followed the lithology of the sample area. The concentrations observed were similar to those reported for many areas of North America.

Rutgers U., New Brunswick, N. J.

Shalhevet, J., and Zwerman, P. J. NITROGEN RESPONSE OF CORN UNDER VARIABLE CONDITIONS OF DRAINAGE--A LYSIMETER STUDY. Soil Sci. 93: 172-182. 1962.

The problem of the nitrogen nutrition of plants in poorly aerated soils may be considered in light of plant physiology, soil microbiology, soil chemistry, and their interactions as reflected in plant growth (the agronomic aspect). In this study attention was given mainly to the last aspect, plant growth.

When anaerobic or partially aerobic conditions exist in the soil, nitrogen (especially nitrate nitrogen) tends to be lost very rapidly by either volatilization or leaching.

This lysimeter experiment determined the importance of nitrogen deficiency in corn growing in poorly drained soil, and investigated the mitigation of the deleterious effects of poor drainage through nitrogen fertilization.

The following conclusions were made: (1) The addition of nitrate to a continuously saturated Lima sil increased gain yields significantly. The final yields, however, were well

below the yields of the well-drained soil. (2) Under the same conditions, nitrate was a somewhat better source of nitrogen than ammonium; however, under well-drained conditions there was no difference. (3) Under all drainage conditions, higher concentrations of nitrogen in the corn stover correlated with higher yields. And (4) the uptake of phosphorus and potassium, as reflected in the concentration of these nutrients in the corn stover, was limited only under conditions of continuous saturation. When conditions of poor aeration were not extreme, no differences in P and K concentrations in the stover were found.

The most important cause of poor plant growth in poorly drained soils is the low oxygen content of such soils. Nutrient and water uptake may be influenced by the same mechanism that influences top growth, but when an adequate supply of nutrients is available, restricted nutrient uptake does not seem to be the cause of the poor growth.

Cornell U. Agr. Expt. Sta., N.Y. State Col. Agr., Ithaca, N.Y.

Bauer, W. J. ECONOMICS OF URBAN DRAINAGE DESIGN. J. Hydraul. Div., ASCE 88 (HY 6): 93-114. Nov. 1962.

The problem of urban-drainage design is viewed as primarily one of space allocation. In spite of large investments in storm sewers in urban areas, the problems associated with severe rainstorms cannot be solved without a system of controlling the location of the volumes of water that occupy space in a watershed during and after periods of excessive rainfall.

Principles underlying the calculation of the volumes of water involved are stated with the aid of the term air-water space, which is the space normally occupied by air but occasionally occupied by water from precipitation. Air-water space is divided into two parts, one above and one below the surface of the earth. The terms flood control and drainage are then seen to be matters of management of air-water space, and of the design, location, or exclusion of objects in air-water space.

The law of continuity is applied to air-water space to establish a basis for the calculation of volumes of water. The law is applied to a bounded portion of air-water space in the conventional manner, with the difference between the inflow and outflow being the time rate of change of storage within this space. Increased discharge capacity in one area must result in increased storage in an adjoining area. The law of conservation of energy is also stated and considered for air-water space. The economic aspects of management of air-water space are examined briefly. The idea of measuring the performance of a conveyance system in terms of dollars per cubic foot per second in transporting water from one point to another is introduced, and the associated significance of streamlining is illustrated.

The principles are then illustrated by application to the Chicago Metropolitan Area during the storm of July 1957. A greater volume of water was shown to have been stored temporarily on the surface in the urbanized portion of the watershed than was stored on the surface of the more rural portion of the watershed, even though the peak rate of runoff from the urban area was on the order of nine times that from the rural area.

Despite the great cost of urban drainage systems of the Chicago type, such systems by themselves do not secure protection from damages from the more severe storms. Better management of air-water space is required, with improved control of the location of the temporary storage if damages are to be minimized to the greatest possible extent. Such control must exist at individual buildings and properties if maximum protection is to be achieved. Criteria for planning the design of drainage in metropolitan areas are presented. These involve considerations of the design storm, of the effect of future urbanization, of storm-sewer capacity, of multiple-purpose projects, of the importance of assessing benefits, and of the regulation of the use of natural flood plains.

In planning either new systems or improvements to existing systems, four steps are recommended: (1) Allocate sufficient space in the watershed for the volume of water that will temporarily occupy portions of air-water space during severe storms at specific locations; (2) consider the cost of downstream storage in evaluating the economic justification of transportation systems; (3) strive for multiple-purpose use of space used for temporary storage of storm water; and (4) restrict the construction of damageable structures in natural flood plains, and in other areas subject to flooding.

Bauer Engin. Co., Chicago, Ill.

## Storage and Conveyance

Holtz, W. G., and Walker, F. C. SOIL-CEMENT AS SLOPE PROTECTION FOR EARTH DAMS. J. Soil Mechanics and Found. Div., ASCE 88 (SM 6): 107-134. Dec. 1962.

The high cost of riprap facings for earth dams has indicated a need for investigating other methods for slope protection. Properties of such facings may be divided into two parts: Erosion resistance to wave action and climatic conditions; and properties that influence the performance of the structure protected. Beginning with developments for soil-cement in highway construction, modifications were evaluated through a series of laboratory tests to establish a basic mix and construction procedure for an experimental test section. The results of a 10-year performance test are evaluated and modifications in mix design, construction procedure, and structure design are determined for application to a dam under construction.

The paper contains suggestions for selecting soils, performing laboratory tests, evaluating test results, and modifying designs to make soil-cement facings applicable.

Site Requirements.--Although it appears feasible to use soil-cement facing with any earth dam project, it seems desirable to limit its consideration to sites at which it has promise of being both effective and economical, when compared with riprap facings. The following factors should prevail to make it effective: A reasonably firm foundation so that deformation following placement of the soil-cement is not significant; site conditions that favor locating the impervious diaphragm of the dam at the upstream face, or a dam with essentially a homogeneous section; and a situation where freeboard does not have to be increased to allow for wave runup. (A freeboard allowance of 1.2 times the wave height seems reasonable for soil cement.) To be economical, materials suitable for manufacture of soil-cement should be readily available. Wet weather has considerable influence on the cost of placing soil-cement.

Material Requirements.--Cohesionless sandy soils containing from approximately 10 to 25% fines can be adequately stabilized with from 0.7 to 1.0 barrel of cement per cu. yd. of compacted soil-cement to provide a good soil-cement facing. These soil fines can be varied somewhat without serious effects.

Yale U., New Haven, Conn.

Jones, C. W., and Lowitz, C. A. COMPACTED LOESSIAL-SOIL CANAL LININGS. J. Irrig. and Drain. Div., ASCE 88 (IR 4): 1-22. Dec. 1962.

The performance of compacted-soil canal linings has been of concern in severe climates where factors such as freezing and thawing action could conceivably reduce soil density and lessen the effectiveness of the lining as a water barrier.



Results of significant field and laboratory tests obtained to date (1962) on loessial-type soil of compacted linings located in southcentral Nebraska are presented. Tests on many soil types in soil linings have shown that the loessialtype soils generally are the most affected by freezing and thawing. The tests include: Field density; field seepage by the ponding method; laboratory compaction, Atterberg limits; gradation; permeability; and freeze-thaw. The authors concluded:

1. Density tends to decrease in compacted soil lining because of freezing and thawing action. The average decrease on the Franklin Canal was approximately 7 percent during the first 2 years after lining construction. The decrease ranged from a minimum of 3 percent near the bottom of the lining to a maximum of 16 percent near the top.
2. The magnitude of density decrease varies inversely with depth, the change being generally much less significant with overburden loads of more than 1 p.s.i. (approximately 1.5 feet of wet material for the loessial soil studied).
3. For a decrease in soil density below 95 percent of the Proctor maximum (the usual minimum field placement requirement), as caused by laboratory freeze-thaw tests, the permeability rate increases, with the increase in rate becoming rapid when the density is less than 90 percent.
4. The increase in permeability, with decrease in density by freezing and thawing, is significantly less for soil having plastic indexes of 16 to 18 than for soil having indexes of 8 to 10.
5. Although there has been a decrease in soil density on Franklin Canal, field seepage tests 3 years after construction showed that the lining was adequately performing its function of reducing canal seepage.
6. The laboratory tests on Courtland Canal soil showed that seepage through the particular reach of lining investigated was caused by factors other than freezing and thawing action and that the soil, if compacted to 95 percent of the Proctor maximum in a lining, would adequately reduce seepage. The lining was reconstructed using the same soil.
7. There is some variation in density of soil in a canal lining, sometimes within short distances, which requires numerous tests for good statistical average values. The five density tests at each of three stations of a test reach is considered to be a minimum number to be obtained at one time for computation of average values.

Bur. Reclam., U.S. Dept. Int., Denver. Colo.

Johnson, E. G. SOIL-CEMENT FOR CHANNEL STABILIZATION; EVALUATION OF COMPACTED AND PLASTIC SOIL-CEMENT LININGS. Agr. Engin. 43: 402-404. 1962.

Both compacted and plastic soil-cement linings have proved to be effective and economical materials for channel stabilization at Naval activities. Compacted soil-cement channels are in very good condition after 4 years at the U.S. Naval Weapons Industrial Reserve Plant, Calverton, Long Island, N.Y. Plastic soil-cement channels have shown little if any deterioration 8 years after placement at the U.S. Naval Auxiliary Air Station, Whiting Field, Milton, Fla.

These two installations of soil-cement channel linings were briefly described and their effectiveness evaluated.

From these channel installations it was concluded that: (1) Plastic soil-cement appears to be ideally suited for channel linings for sandy soils; (2) the plastic method is particularly applicable to narrow channels and/or sections having a high percentage of

steep slopes; (3) proper protection of the channel edges and periodic repair and refilling of the mastic joints are essential maintenance features; and (4) this method is particularly useful when local or in-place soil materials can be used.

Staff. Conserv., Atlantic Div., Bur. Yards and Docks, Area Public Works Off., U.S. Dept. Navy, N.Y.

Tanner, W. B., and Dale, V. PRESENT STATUS OF EVAPORATION REDUCTION BY CHEMICAL FILMS. U.S. Army Engin. Waterways Expt. Sta. Misc. Paper 5-475, 34 pp. 1962.

A review of the literature on the use of chemical films to reduce evaporation in reservoirs was made to determine if these films were suitable for use in Corps of Engineers reservoirs. The literature revealed that the application and maintenance of monomolecular films on large reservoirs present a number of problems yet to be solved. These problems include development of more effective methods of applying and maintaining the film, control of biochemical oxidation, and development of methods of determining the extent of film coverage. Once the obstacles are overcome, the technique should be of considerable value (except for humid areas), particularly for those reservoirs supplying water for industrial and/or municipal use.

In fiscal year 1960, the Corps of Engineers provided about 1.5 million acre-foot of storage in 19 reservoirs for more than 40 cities, with an additional 660,098 acre-foot of storage to be provided by projects under construction. During the year, about 1 million acre-foot of water was supplied for domestic and industrial use. About 4 million acre-foot of storage was operated either exclusively or jointly for irrigation and other uses. It is likely that such storage will increase since the Water Supply Act of 1958 provides a broader authority for the provision of water supply storage for future needs.

An annotated bibliography of 54 papers is included.

U.S. Army Engin. Waterways Expt. Sta., Corps of Engineers, Vicksburg, Miss.

Davison, V. E., Lawrence, J. M., and Compton, L. V. WATERWEED CONTROL ON FARMS AND RANCHES. U.S. Dept. Agr. F. B. 2181, 22 pp. 1962.

Waterweeds present serious problems in agricultural water whether it is impounded for irrigation, livestock, fish, wild ducks, or for other purposes. At least 100 kinds of troublesome waterweeds grow in the South, and no section of the United States is free from them. Some kind of waterweeds or troublesome water plants will invade most impoundments unless they are properly managed. Specific recommended management practices are:

1. For waterweed prevention: (1) Deepen the edges of marshes and fill them in; (2) fertilize open water enough to shade out sunlight and keep organic matter to a minimum; and (3) allow for wind action on the surface or keep ducks on the area to control duckweeds.
2. For waterweed control: (1) Graze or mow grasses, shrubs, and vines on areas around ponds; (2) keep mullet in the pond to control branched-filament algae in brackish widgeongrass duck-ponds; (3) keep Israeli carp in the pond to control branched-filament algae in fresh-water ponds; (4) use copper sulfate or place algae-eating fish in the pond for single-filament algae; (5) use a spray of esters of 2,4-D in diesel oil for edge and marsh plants (Dalapon or 2,4-D may be used on

cattails; (6) use ammate, 2,4-D, 2,4,5-T, or silvex for troublesome shrubs and trees around ponds; (7) use sodium arsenite, silvex, or 2,4-D granules for most submersed weeds in ponds and submersed weeds and duckweeds growing together; (8) apply fertilizer on the weed beds in winter for submersed weeds in southern and mid-United States latitudes; (9) in irrigation and drainage ditches use aromatic solvents (with emulsifiers) for submersed weeds; (10) use silvex or 2,4-D granules for waterlilies and watershield; (11) spray frequently with amine salts of 2,4-D mixed with water for water-hyacinths; and (12) spray with sodium arsenite for water-lettuce.

SCS, USDA, Inform. Div. Washington 25, D.C.

## BASIC SOIL SCIENCE

### Soil Physics

Conaway, A. W., Jr., and Strickling, E. A COMPARISON OF SELECTED METHODS FOR EX-PRESSING SOIL AGGREGATE STABILITY. Soil Sci. Soc. Amer. Proc. 26: 426-430. 1962.

Aggregate stability was determined on samples taken from plots under 10 cropping systems on a Beltsville sil and on samples taken from selected soil types in Maryland, North Carolina, South Dakota, Texas, and Wisconsin. Complete aggregate and mechanical analysis curves were determined on the 2.0- to 4.76-mm. fraction from each soil sample. The method of Bryant et al. (1948) was also used to determine water stability of this fraction.

These data were used to calculate soil aggregate stability by 24 different methods. Duncan's multiple range test was used to determine the ability of each method to distinguish between changes in soil aggregate stability produced by the cropping systems.

In general, simple summation fractions of the waterstable soil aggregates distinguished well between cropping systems and were as sensitive as more time-consuming methods. It was found that changes in aggregate stability were reflected most by the 0.5- to 2.0-mm. aggregates.

Jr. Author, U. Md., College Park, Md.

Rose, C. W. SOME EFFECTS OF RAINFALL, RADIANT DRYING, AND SOIL FACTORS ON INFILTRATION UNDER RAINFALL INTO SOILS. J. Soil Sci. 13: 286-298. 1962.

The effect of the structural condition of a soil on infiltration under laboratory-simulated rainfall was investigated. Infiltration was greater with better structural condition for both undisturbed and disturbed samples. The infiltration rate of a soil surface damaged by intense rainfall decreases as rainfall continues. After equal periods of exposure there was little difference, for any of three soils examined, between total infiltration of rainfall at a rate of 6 in. per hour and at 4 in. per hour. The application of a pressure less than atmospheric to the underside of 2-in.-deep samples, simulating the moisture tension observed in the transmission zone on infiltration into deep soil columns, did not increase infiltration under rainfall as would be expected. For a clay soil previously exposed to rainfall, infiltration rate after radiant drying for 24 hr. and rewetting was only half that of replicates that were dried in shade.

The nature of the cation with which a soil may be saturated markedly affects the permeability of the soil to water, and this effect persisted when water was applied with the added mechanical action of falling drops. Artificial crumbs of pure clays and a clay mixture



were brought to moisture equilibrium with saturated water vapor, and their stability under rainfall examined. Calcium-saturated kaolin crumbs were rapidly broken down and dispersed under rainfall, in marked contrast to their stability on immersion in water without the mechanical effect of falling drops. Calcium-saturated illite and montmorillonite experienced no visible breakdown of the crumbs and no dispersion for the same rainfall exposure.

Makerere U. Col., Kampala, Uganda.

Johnson, W. C. CONTROLLED SOIL CRACKING AS A POSSIBLE MEANS OF MOISTURE CONSERVATION ON WHEATLANDS OF THE SOUTHWESTERN GREAT PLAINS.

Agron. J. 54: 323-325. 1962.

Cracking was induced in a predetermined pattern in a vigorous stand of wheat on Pullman silt well supplied with moisture by removing on April 5, 1960, every 15th or 30th row of wheat in all combinations with transverse 18-inch strips removed at spacings of 10, 20, or 30 feet apart. After a month of dry weather very extensive cracking occurred and large cracks formed along the axes of the bare strips for over 95 percent of their length. An enumeration was made of crack widths over 1/2 cm. wide in the 10-15 treatment. The induced cracks averaged 1-1/2 to 2 times greater in width than the naturally occurring cracks for orientations parallel and perpendicular to the rows, respectively. The naturally occurring cracks had the same average width for both orientations.

Controlled cracking to increase crack size is feasible. On a practical scale it could be accomplished by a technique of variable row spacing and skip seeding. The season for increasing crack size is to reduce the control of the surface soil mulch over the entry of free water into subsurface cracks, thereby promoting the deep and rapid penetration of the surface water.

SWCRD, ARS, USDA, Bushland, Tex.

Tanner, C. B., and Lemon, E. R. RADIANT ENERGY UTILIZED IN EVAPOTRANSPIRATION. Agron. J. 54: 207-212. 1962.

Of the total radiation falling upon a plot of ground, that portion which is transformed into other forms of energy is called the net radiation. The amount of net radiation transformed to sensible heat stored in the soil or in the vegetative volume and that stored photochemically account for only a small part of the total energy transformation taking place at the earth's surface. Most of the energy transformations appear as sensible heat and latent heat which are exchanged with the atmosphere. The division between the two depends upon the amount of water available for evaporation.

Several plant and soil factors interact to affect the direct evaporation of water from the soil and the evaporation of water from plants as a result of the transpiration processes. Soil factors include the moisture content, the soil moisture suction, and the water transmission characteristics. Plant factors include the leaf area, root proliferation, plant type, and perhaps physiological age. Leaf area appears to be of greatest importance directly as a surface to evaporate water and indirectly as a cover to shade the ground. Where water is plentiful, the evaporation process is restricted neither by plant nor soil factors but by the supply of energy available. Under certain circumstances, plants are able to use more energy for evaporation than is supplied by the radiant energy falling on the ground. Thus, the amount of radiation utilized in evapotranspiration can vary from zero, when no water is available, to an evaporation potential exceeding the net radiation (and even the solar radiation) received, when water is plentiful.

U. Wis., Madison, Wis.

NORDENSON, T. J., and Baker, D. R. COMPARATIVE EVALUATION OF EVAPORATION INSTRUMENTS, J. Geophysical Res. 67: 671-679. 1962.

In the summer of 1953, the Weather Bureau initiated an evaporation project at the Observational Test and Development Center located at Silver Hill, Md. The original installation consisted of several class A evaporation pans--BPI (sunken) pan, Colorado (sunken) pan, Young screened (sunken) pan, and a 15-foot diameter sunken pan. The 15-foot-diameter pan is assumed very nearly to simulate a lake. Later, an insulated BPI pan and a new experimental insulated Fiberglas pan were installed. It was concluded that: (1) The proper water level in class A pans must be maintained; (2) monel metal, but not stainless steel, may be used instead of galvanized iron for class A pans; (3) heat exchange between sunken pans and soil cannot be neglected; and (4) general relations previously developed by the Weather Bureau for computing pan and lake evaporation from meteorological factors were well verified.

U.S. Weather Bur., U.S. Dept. Com., Washington, D.C.

Merriam, R. A. USEFUL STATISTICAL GUIDES AND GRAPHS FOR NEUTRON PROBE SOIL MOISTURE SAMPLING. Intermountain Forest and Range Expt. Sta. Res. Paper 62, 9 pp. 1962.

Neutron probes are becoming a standard tool for measuring soil moisture.

Functioning of probes depends on the emission of fast neutrons from a radioactive source placed within the soil profile and the subsequent occurrence and detection of slow or thermal neutrons. These slow neutrons are created by the collision of fast neutrons with hydrogen nuclei. Because the bulk of the hydrogen nuclei in soils is contained in the soil water, the rate at which slow neutrons are created is a measure of soil moisture.

Many users and potential users of neutron probes believe in the desirability of longer counting times at low soil moisture than at high moisture. This is not true when errors in terms of soil moisture are considered rather than errors in counting rate.

A coaxial graph permits the determination of the counting time necessary to satisfy the levels of statistical reliability selected by the researcher at soil moisture contents up to 50 percent by volume for probes having calibration curve slopes between 150 and 400 counts per minute per unit moisture percent by volume.

A graph illustrates the relation between random counting errors at several probability levels and soil moisture. A figure illustrates the magnitude of total counting errors when timing errors and random counting errors are of the same algebraic sign.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Cary, J. W., and Taylor, S. A. THERMALLY DRIVEN LIQUID AND VAPOR PHASE TRANSFER OF WATER AND ENERGY IN SOIL. Soil Sci. Soc. Amer. Proc. 26: 417-420. 1962.

The basic rate equation developed from Onsager's theory and thermodynamics of irreversible processes was modified for liquid phase moisture diffusion. This was done by accounting for the thermal dependence of the phenomenological coefficients with Eyring's theory of rate processes.

The total simultaneous heat and water transfers through unsaturated soil samples were measured as a function of temperature gradient. By making use of the thermal dependence

of vapor flow as reflected in the heat flux data, it was possible to separate the total water transfer into components of vapor phase flow and liquid phase flow. The rate equations were then tested and found to give reliable predictions of water and energy transfer through soil over the range of conditions applied. The interaction coefficients between heat and moisture transfer were also evaluated and found to be approximately the same, which was in agreement with the Onsager theory.

SWCRD, ARS, USDA, Logan, Utah.

Haas, H. J., and Willis, W. O. MOISTURE STORAGE AND USE BY DRYLAND SPRING WHEAT CROPPING SYSTEMS. Soil Sci. Soc. Amer. Proc. 26: 506-509. 1962.

Soil moisture data collected at Mandan, N. Dak., from 1915-54 were summarized to compare water storage and use from soil annually cropped to spring wheat and alternately fallowed and cropped to spring wheat. Consecutive 2-year periods were used for the comparisons. The periods of study began with time of harvest.

Water storage was similar for both systems from harvest to June 1 of the first year. Eighty-four percent of the water stored during an entire fallow period had accumulated by July 1. Conservation of water over the second winter of fallow averaged only 0.02 inch. For the same period of time, the annually cropped soil conserved 1.67 inches. During an entire fallow period (about 21 months) only 4.36 inches of a possible 22.73 inches were stored. For the same period, an annually cropped soil stored 2.60 inches.

Only 4 more inches of water was used by the annual cropping system in producing a wheat crop averaging 15 bushels per acre than was used during the same period by fallow where a crop had not been grown.

SWCRD, ARS, USDA, Mandan, N. Dak.

Lemon, E. R. SOIL AERATION AND PLANT ROOT RELATIONS: I. THEORY. Agron. J. 54: 167-170. 1962.

In order to make a rational approach to the physics of gas exchange between plant roots and the soil environment, a simple model was proposed. The following assumptions were made: (1) Complete cylindrical symmetry of two co-axial diffusion fields represents the two facets of the problem; one exterior to the root wall (the soil environment), and one interior to the root wall (the root itself); (2) no longitudinal gradients exist; (3) steady-state oxygen flux is operative; (4) oxygen sink strength in the exterior field is insignificant; and (5) oxygen sink strength in the root is independent of oxygen concentration above the critical oxygen level.

The solution of the diffusion equation for the two cases pinpoints the need to consider the problem of soil aeration as a unified soil-plant problem. One needs to know the oxygen demand characteristics of the plant root as well as the oxygen supplying power of the soil. The root and soil parameters needed in the solution of the total problem were given. While all of the assumptions made are not true in the absolute sense (Nos. 1, 2, and 4), the conclusions drawn from the application of the simple model should not be too much in error in the broad picture developed.

SWCRD, ARS, USDA, Ithaca, N.Y.



Lemon, E. R., and Wiegand, C. L. SOIL AERATION AND PLANT ROOT RELATIONS:  
II. ROOT RESPIRATION. Agron. J. 54: 171-175. 1962.

To adequately characterize the oxygen "supplying power" of the environment around a root growing in the soil, it is necessary to know the critical "demand" characteristics of the root. As a natural sequel to the theoretical development of the problem, a brief review of the factors determining these "demand" characteristics is given. The evidence indicates that: (1) The rate of metabolic oxygen uptake by root tissues varies with the genetic background and the physiological age of the tissue. These give rise to differences in intensive and extensive characteristics such as metabolic "pathways" and concentration of reaction loci. (2) When oxygen is plentiful, the "substate" supply (or other necessary compounds) at the reaction loci determines the reaction rate. Chemical processes involved in "substate" supply are particularly sensitive to temperature. (3) When the oxygen concentration at the root surface is below the critical level, diffusion controls the rate of oxygen uptake. This physical process is relatively insensitive to temperature. And (4) the critical oxygen concentration at the root surface is strongly dependent upon the radius of the root and the diffusion coefficient of oxygen within the root.

SWCRD, ARS, USDA, Ithaca, N.Y.

## Soil Chemistry and Minerology

Alekseyeva, V. V. INFLUENCE OF EXCHANGEABLE  $H^+$ ,  $Al^{+++}$ , AND  $Na^+$  ON THE AVAILABILITY OF SOIL PHOSPHORUS AND PHOSPHORITE TO PLANTS. Soviet Soil Sci. 1: 30-35. Jan. 1961.

The following conclusions were established in pot and laboratory experiments using cationites saturated with hydrogen, aluminum, or sodium: (1) When applying a cationite containing exchangeable hydrogen or aluminum ions to soil, the uptake of phosphorus by plants from phosphorite increased. (2) The interaction of ground phosphorite with the H-cationite led to the decomposition of phosphorite, accompanied by the dissolution of phosphorus. (3) Two processes took place during the interaction of phosphorite with the Al-cationite: the decomposition of phosphorite and the dissolution of phosphorus, and its subsequent precipitation from the solution by aluminum ions. (4) The interaction of phosphorite with the Na-cationite led only to a slight increase of the solubility of phosphorite. (5) The addition of the H-cationite to soil (thick chernozem) considerably increased the uptake of soil phosphates by plants. And (6) a lesser ability of the Al-cationite to decompose phosphorite as compared to the H-cationite was established in laboratory experiments.

Amer. Inst. Biol. Sci., 2000 P. St., N.W., Washington 6, D.C.

Elgabaly, M. M. ON THE MECHANISM OF ANION UPTAKE BY PLANT ROOTS:  
II. EFFECT OF THE CATION-EXCHANGE CAPACITY OF PLANT ROOTS ON  $Cl^-$  UPTAKE. Soil Sci. 93: 350-352. 1962.

In a study of the effect of the cation-exchange capacity of roots on  $Cl^-$  uptake,  $Cl^-$  uptake from  $CaCl_2$  and  $NaCl$  by excised roots of barley, alfalfa, peas, and soybeans with cation-exchange capacities of 12, 45, 53, and 65 me./100 g., respectively, was found to be in the order: barley > alfalfa > peas > soybeans, which is the reverse order of their capacities. When, in alfalfa and beans, the roots were placed in  $Cl^-$  resin,  $Cl^-$  uptake greatly increased. Barley roots take up relatively more  $Cl^-$  than  $SO_4^{=}$ .

These results are explained on the assumption that roots with higher cation capacity are expected to possess higher negative charges, which may tend to repel  $\text{Cl}^-$ , and the further assumption that  $\text{Cl}^-$  resin interacts with the highly negatively charged roots to reduce the charge and cause more  $\text{Cl}^-$  uptake. On the basis of Donnan equilibria, both the effect of cation-exchange capacity of the root on  $\text{Cl}^-$  uptake, and that of anion valence on relative uptake of  $\text{Cl}^-$  and  $\text{SO}_4^{2-}$ , can be explained.

U. Alexandria, Alexandria, Egypt, U.A.R.

Aomine, S. A REVIEW OF RESEARCH ON REDOX POTENTIALS OF PADDY SOILS IN JAPAN. Soil Sci. 94: 6-13. 1962.

The redox potential of the plowed layer ( $A_p$  horizon) of paddy soils rapidly drops to below 0.30 volts at pH 6 after waterlogging on the whole mass. Thus reducing nitrate, manganese dioxide, ferric iron, and sulfate to nitrogen gas, manganous manganese, ferrous iron, and sulfide, respectively, and forming certain gases and organic acids. In some degraded soils, rice plants have physiological diseases owing to reduced products, such as hydrogen sulfide. Reduced-surface soils easily recover the oxidized condition (above  $E_h + 0.30$  volts) by drainage.

The redox potential of the B horizon of the soils, however, is only slightly affected by waterlogging and drainage, persisting in the oxidized condition throughout the year. This persistence of the oxidized layer under the reduced layer is one of the characteristics of a well-drained paddy soil.

Waterlogged soils develop a very thin oxidized layer a few millimeters thick at the surface, and, in general, they include oxidized portions even in the reduced layer. Such heterogeneity of the redox potential causes nitrogen to be lost from the soils, but it is favorable to the healthy growth of rice plants.

Kyushu U., Kyushu, Japan.

Key, J. L., Kurtz, L. T., and Tucker, B. B. INFLUENCE OF RATIO OF EXCHANGEABLE CALCIUM-MAGNESIUM ON YIELD AND COMPOSITION OF SOYBEANS AND CORN. Soil Sci. 93: 265-270. 1962.

Soybean and corn plants were grown in the greenhouse in both soil and sand-resin cultures which had been prepared to provide wide ranges of ratios of exchangeable Ca:Mg and cation-exchange capacities.

In the soil medium, no significant effect of Ca:Mg ratio was found, but difficulties in preparing the soils and the high variability of results may have obscured possible results. A tendency to poorer growth was observed when the Ca:Mg ratio was less than 1.0.

In sand-resin cultures, no effect of the Ca:Mg ratio was found when Ca exceeded Mg, and differences in growth were associated with amounts of those ions rather than their ratios. Poor growth always occurred when the Ca:Mg ratio was less than 1.0.

Poorer growth of soybeans appeared to result from insufficient amounts of Ca or Mg rather than from unfavorable ratios. Soybeans did not grow as well in the medium with 3 me. C.E.C. (cation-exchange capacity) as in those with 9 and 27 me. C.E.C. Plant symptoms and composition indicated that at 3 me. C.E.C., the plants were Ca-deficient at all Ca:Mg ratios. Corn plants, on the other hand, grew well at all C.E.C. levels, but only when the Ca:Mg ratio was greater than 1.0.

Phosphorus uptake, which is reportedly increased by Mg, was not influenced appreciably except when Mg exceeded Ca in the growth media.

U. Calif., Davis, Calif.

Crooke, W. M., and Knight, A. H. AN EVALUATION OF PUBLISHED DATA ON THE MINERAL COMPOSITION OF PLANTS IN THE LIGHT OF THE CATION-EXCHANGE CAPACITIES OF THEIR ROOTS. *Soil Sci.* 93: 365-373. 1962.

An evaluation was made of the data of various workers on the chemical composition of crop plants and weeds in terms of the cation-exchange capacity (C.E.C.) of the roots of these species, using values obtained either from the literature or from measurements made in this laboratory.

It was shown that C.E.C. of the roots is positively correlated with the total cation, ash, excess base, and total trace elements contents in the tops. C.E.C. and ash content, a positive correlation with protein content and ether extract, and a negative correlation with crude fiber. Soluble carbohydrates appeared to be almost independent of ash content.

The listing of plant species according to ascending C.E.C. of their roots is interpreted in terms of a change from a carbonaceous type of plant to a proteinaceous plant.

Macaulay Inst. for Soil Res., Aberdeen, Scotland.

Chin, W., and Kroontje, W. MECHANISMS OF UREA ADSORPTION BY SOILS. *Soil Sci. Soc. Amer. Proc.* 26: 479-481. 1962.

Physically adsorbed urea may be easily desorbed by dilution. Chemisorbed urea existing primarily in the form of relatively stable soil organic matter-urea complexes may, in part, be slowly dissociated upon dilution.

Differences among soil types with respect to urea adsorption were primarily related to organic matter contents. The effects of C.E.C. (cation exchange capacity) pH, and clay mineral content were insignificant. Wet soils had a lower capacity for urea adsorption than dry soils. Considering the amounts of urea adsorbed, soils have, in general, a weak affinity for the urea molecule.

Va. Polytech. Inst., Blacksburg, Va.

Chao, T. T., and Harward, M. E. NATURE OF ACID CLAYS AND RELATIONSHIP TO ION ACTIVITIES AND ION RATIOS IN EQUILIBRIUM SOLUTIONS. *Soil Sci.* 93: 246-253. 1962.

Relationships of kind of clay mineral, nature of acid clays, and degree of Ca saturation to pH, calcium ion activity, and the function  $\text{pH}-1/2 \text{ pCa}$  of equilibrium solutions were studied, using known clay minerals. The general features of titration curves were independent of the kind of clay and dependent on the nature of the acid clay (H vs. Al saturation). All H-saturated clays exhibited strong acid properties. Strong acid properties of H kaolinite indicated a need for reexamination of the concept that weak-acid properties of kaolinite can be ascribed to SiOH groups on the terminal edges of clay crystals.

The greater release of Ca from clays containing exchangeable Al than from those containing exchangeable H was consistent with the complementary ion effect. It was found, however, that equilibration in  $0.01 \text{ M CaCl}_2$  as contrasted to water, minimized the effects of kind of clay and acidic nature of the exchange complex.

The change of  $1/2 \text{ pCa}$  with degree of Ca with degree of Ca saturation was smaller than that of pH values. Consequently, curves relating the function  $\text{pH}-1/2 \text{ pCa}$  to Ca saturation had the same general shape as the corresponding titration curves. Simple linear relationships did not occur, although they were most closely approached for the Al-saturated clays equilibrated in water.

Oreg. State U., Corvallis, Oreg.



Gradusov, B. P., and Dyazdevich, G. S. CHEMICAL AND MINERALOGICAL COMPOSITION OF CLAY FRACTIONS IN STRONGLY PODZOLIC SOILS IN CONNECTION WITH ELEMENT MIGRATION. Soviet Soil Sci. 7: 749-756. July 1961.

The clay material of a strongly podzolic soil is mobile. In the lower part of the A<sub>2</sub> horizon, and especially in the B horizon, it separates into optically oriented shells around particles of the primary minerals and of "coatings" at their wedges, and intrusions in the micropores and cracks in combination with organic matter and iron.

In the podzolic horizon the relative order of mobility of the elements is  $K > Ca > Mg > Si > Al = Fe$ . In this horizon, all elements except the quartz silica which shows a relative accumulation, proved highly mobile.

The composition of the clay fractions included clay minerals (montmorillonite and kaolinite with a slight admixture of hydromica), amorphous iron, alumina compounds, goethite, and organic mineral compounds. The total chemical composition of clay was characterized by a low potassium and magnesium content and a  $SiO_2:R_2O_3$  ratio of 2.5-2.7.

There was a relative accumulation of kaolinite the top part of the podzolized horizon. An increased content in montmorillonite and in the amorphous  $R_2O_3$  compounds was found in the illuvial horizon and goethite was detected. The clay matter of the ortsand interlayer showed a high hydromicaceous mineral content.

Amer. Inst. Biol. Sci., 2000 P. St. N.W., Washington 6, D.C.

Turner, R. C., and Nichol, W. E. A STUDY OF THE LIME POTENTIAL: I. CONDITIONS FOR THE LIME POTENTIAL TO BE INDEPENDENT OF SALT CONCENTRATION IN AQUEOUS SUSPENSIONS OF NEGATIVELY CHARGED CLAYS. Soil Sci. 93: 374-382. 1962.

Experiments conducted to gather information concerning the lime potential of aqueous suspensions of negatively charged clays showed: (1) Within experimental error, the lime potential was independent of the ratio of Ca to Mg in the system. (2) The ratio of exchangeable to solution Ca below which the lime potential was sensitive to salt concentration. A ratio of 1.0 or greater, calculated on the basis of a salt concentration of  $10^{-2}M$ , should insure constancy of  $pH - 1/2pCa$  with all lower concentrations, except possibly at very low percent base saturation. And (3) the presence of exchangeable Al was neither a necessary nor a sufficient condition for the lime potential to be independent of salt concentration. Al could be replaced with Fe or La (Lanthanum) without affecting the constancy of the lime potential with varying salt concentrations, and even if exchangeable Al was present the pH of the solution had to be such that a reversible reaction existed between Al and OH.

Organic exchange material did not always behave the same as clays with respect to the lime potential.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

Turner, R. C., and Nichol, W. E. A STUDY OF THE LIME POTENTIAL: II. RELATION BETWEEN LIME POTENTIAL AND PERCENT BASE SATURATION OF NEGATIVELY CHARGED CLAYS IN AQUEOUS SALT SUSPENSIONS. Soil Sci. 94: 58-63. 1962.

It was shown that, when clays were saturated with Al and then titrated with  $Ca(OH)_2$ , the lime potential of the solution was directly related to percent base saturation, regardless of clay used. This conclusion was based on the condition that base saturation referred to saturation of the permanent charges on the clay.

Clays saturated with Fe behaved in the same manner as the Al-saturated clays, except that the lime potential at a given percent base saturation was lower. It was indicated that Al can be replaced with any other trivalent cation, providing the hydroxide of the cation is relatively insoluble, without affecting the relation between lime potential and percent base saturation. The magnitude of the lime potential at a given degree of base saturation depends on the solubility of the hydroxide of the metal ion involved.

Experiments in which bentonite was originally saturated with mixtures of Fe and Al showed that the lime potential is not always a true measure of degree of base saturation even if the exchangeable cations counter to Ca are predominantly Al.

The lime potential will show whether the clays have any appreciable fraction of their permanent charges neutralized by exchangeable Al or Fe. A pH measurement alone may not do this.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

Tiller, K. G., and Hodgson, J. F. THE SPECIFIC SORPTION OF COBALT AND ZINC BY LAYER SILICATES. In CLAY AND CLAY MINERALS. 9: 393-403. 1962.

The sorption of Co and Zn by layer silicates was studied in dilute mineral suspensions containing about  $10^{-6}$  M Co or Zn. Electrostatic adsorption was eliminated by the presence of 0.1 N  $\text{CaCl}_2$ . Co and Zn were determined by a radioisotopic technique.

Detailed studies on montmorillonite and to a lesser extent vermiculite, muscovite, and biotite revealed the presence of at least two forms of specifically sorbed Co. One was exchangeable by certain ions such as Cu, Ni, Zn, Fe, Mn, or more Co; the other was not. The latter form is considered to result from lattice penetration; the former is associated with surface groups. These forms may be separated quantitatively by several desorption procedures including successive extractions with dilute acetic acid.

The total amount and relative proportion of these forms of sorbed Co and Zn depend on the pH of the system, time of reaction, mineral species used, and amount of Co or Zn added. Equilibrium is not readily attained but tends to approach a slow steady state after several days. Isotherms indicate a variation in bonding energy with surface coverage. The sorption of Co and Zn from dilute solutions by any mineral is related to its stability.

These studies suggest that a common mechanism may be involved in the specific sorption of many heavy metal cations by many minerals.

Jr. Author, U.S. Soil Plant and Nutr. Lab., SWCRD, ARS, USDA, Ithaca, N.Y.

Hodgson, J. F., and Tiller, K. G. THE LOCATION OF BOUND COBALT ON 2:1 LAYER SILICATES. In CLAY AND CLAY MINERALS. 9: 404-411. 1962.

Three techniques were used to determine what clay mineral surfaces are involved in the selective bonding of Co: (1) Polyphosphate ions were used to block edge surfaces of montmorillonite and vermiculite from Co; (2) collapse of the interlamellar spaces with potassium saturation was used to block internal basal surfaces of vermiculite from Co; and (3) autoradiographs were prepared of vermiculite and mica particles that had reacted with Co-58. In each case Co in low concentration was allowed to combine with the mineral in the presence of high concentrations of  $\text{CaCl}_2$ .

The preliminary sorption of polyphosphate ions had no appreciable effect of the sorption of Co by the minerals studied, indicating that the edge surfaces were not likely to be involved

in the Co reaction. The blocking of internal basal areas had only a very slight effect, suggesting that these surfaces were involved in the sorption of Co, but only to a limited extent. Autoradiographs of naturally occurring vermiculite particles revealed a somewhat uneven distribution of Co over the planar surface of the particles. Removal of the outer layers of the crystals, either before or after the material had combined with Co but before autoradiography, resulted in a concentration of the metal along edges and cracks.

Apparently the external basal surfaces are principally involved in the specific sorption of Co by layer silicates. It is suggested that chemical weathering and physical abrasion of the surfaces introduce defect structures which favor the chemical bonding of heavy metals.

U.S. Soil Plant and Nutr. Lab., SWCRD, ARS, USDA, Ithaca, N.Y.

McCants, C. B. SEASONAL DISTRIBUTION OF NUTRIENTS IN SOIL UNDER TOBACCO CULTURE. Soil Sci. 94: 37-43. 1962.

The seasonal distribution of N, K, Ca, Mg, and P, and changes in soil pH in soil fertilized for tobacco was investigated on different soil types and under different rainfall patterns. Soil samples were taken periodically during the growing season at 0 to 4, 4 to 8, and 8 to 12 inches below the point of fertilizer application.

There was no evidence of N or K movement below 4 inches from the point of fertilizer application if the total rainfall during the 7 weeks after transplanting tobacco was less than 6 inches and if it was fairly evenly distributed over this period in the form of showers of 1/2 inch or less. Accumulated rainfall over a 2- to 3-day period of 2 inches or more, which occurred either prior to or during the period of maximum nutrient absorption, resulted in considerable leaching of N and K. Similar rainfall conditions occurring late in a season that had been unfavorable for growth and nutrient absorption likewise resulted in the leaching of these elements. Whether leaching occurred early or late in the growing season, the pattern was similar and was characterized by a fairly uniform distribution of the elements in the sampling zone. No mass movement of N or K was observed under any of the climatic or soil conditions studied.

Rainfall conditions that were favorable for the leaching of N and K had little or no influence on the movement of Mg, Ca, or P below 4 inches from the point of application. In general, at each sampling depth the soil pH decreased during the growing season.

N.C. State Col., Raleigh, N.C.

Barrows, H. L., and Simpson, E. C. AN EDTA METHOD FOR THE DIRECT ROUTINE DETERMINATION OF CALCIUM AND MAGNESIUM IN SOILS AND PLANT TISSUE. Soil Sci. Soc. Amer. Proc. 26: 443-445. 1962.

An EDTA procedure is described for the direct determination of Ca and Mg in soils and plant tissue. These elements are determined in the ammonium acetate leachate of soils and in the 1N HNO<sub>3</sub> solution of the plant ash. Calcium is separated from Mg by precipitating calcium sulfate from ethanol and is determined in the precipitate. Magnesium is determined in the supernatant solution. Manganese may be present in concentrations likely to interfere with the Mg titration, but this interference is easily eliminated. The accuracy and precision of the method are well within the limits required for routine analyses.

SWCRD, ARS, USDA, Beltsville, Md.



Lindsay, W. L., Frazier, A. W., and Stephenson, H. F. IDENTIFICATION OF REACTION PRODUCTS FROM PHOSPHATE FERTILIZERS IN SOILS. Soil Sci. Soc. Amer. Proc. 26: 446-452. 1962.

Approximately 30 crystalline phosphate compounds, in addition to colloidal precipitates of variable composition, were identified as reaction products following the addition of various fertilizer solutions to soils and soil constituents. Identifications were made by means of X-ray, petrographic, and chemical analyses. The findings helped to clarify the mechanism of phosphate reactions in soils, which includes the dissolution of fertilizer and soil constituents and the precipitation of new products.

Colo. State U., Fort Collins, Colo.

Taylor, A. W., and Gurney, E. L. PHOSPHATE EQUILIBRIA IN AN ACID SOIL. J. Soil Sci. 13: 187-197. 1962.

A detailed study of the aluminum phosphate ion products in solutions equilibrated with an acid, phosphate-deficient soil showed that the phosphate status of the undisturbed soil is compatible with the existence of variscite ( $\text{AlPO}_4 \cdot (\text{H}_2\text{O})_2$ ) in the soil, but produced no evidence that this phase has any effect in controlling the composition of dilute solutions equilibrated with the soil for periods of less than 32 days.

When the soil is acidified, subsequent changes in the composition of the solution reflect the dissolution of aluminum hydroxide and decay of the clay minerals. Phosphate additions to the acidified soil are rapidly precipitated, and the final phosphate concentration is less than would be supported by variscite under these more acid conditions.

Div. of Chem. Development, TVA, Wilson Dam, Ala.

Chakravarti, S. N., and Talibudeen, O. PHOSPHATE EQUILIBRIA IN ACID SOILS. J. Soil Sci. 13: 231-240. 1962.

Phosphate equilibria in 54 acid soils were examined and referred to equilibria with variscite and strengite. The equilibrium phosphate concentration in British soils is governed by phosphate residues less basic than these compounds and is approximately similar to that obtained by treatments of montmorillonite with  $10^{-5}\text{M}$  phosphate solutions for 9 months. In Indian soils, both compounds are effective in controlling phosphate concentrations over the pH range 3.8-5.7.

Kaolinite and glauconite treated with  $10^{-5}\text{M}$  phosphate for 9 months exhibited characteristics intermediate between the two groups of soils.

Rothamsted Expt. Sta., Harpenden, Herts, England.

Chu, C. R., Moschler, W. W., and Thomas, G. W. ROCK PHOSPHATE TRANSFORMATIONS IN ACID SOILS. Soil Sci. Soc. Amer. Proc. 26: 476-478. 1962.

A study of several Virginia soils revealed that rock phosphate breakdown into both Al- and Fe- fractions decreased with increasing pH. The relationship between pH and Al-phosphate was essentially the same for all soils studied. The amount of Fe- phosphate formed varied both with pH and soil free Fe content. It appears that soils which respond well to rock phosphate applications are those with low pH and relatively low free Fe content.

Graphs.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Broadbent, F. E., and Tyler, K. B. LABORATORY AND GREENHOUSE INVESTIGATIONS OF NITROGEN IMMOBILIZATION. Soil Sci. Soc. Amer. Proc. 26: 459-462. 1962.

Immobilization of tracer nitrogen added as ammonium sulfate or as nitrate was followed by analysis of inorganic nitrogen in Moreno sl and Sacramento c during the course of incubation experiments. In Sacramento c receiving ammonium sulfate plus straw, the nitrifying bacteria were able to compete effectively with the immobilizing flora for nitrogen, whereas in the Moreno sl this was not the case. In both soils immobilization attained a maximum in 6 to 10 days. There was some increase in inorganic nitrogen thereafter, but none of this resulted from remineralization of the tracer nitrogen added initially. In greenhouse experiments competition for added tracer nitrogen between a growing crop and the immobilizing flora emphasized preferential utilization of ammonium nitrogen by soil microorganisms and of nitrate nitrogen by the crop. In Moreno sl, overall recovery of the added tracer was higher under treatments favoring immobilization than in pots receiving only fertilizer.

U. Calif., Davis, Calif.

Allison, F. E. NITROGEN TRANSFORMATIONS IN SOILS. Soil and Crop Sci. Soc. Fla. Proc. 21: 248-254. 1961.

The many and varied things that can happen to soil and fertilizer nitrogen was discussed. It may migrate back and forth between the organic and inorganic forms readily. This may cause some of the nitrogen to be made temporarily unavailable and also there are many opportunities for loss in the drainage waters and to the atmosphere.

In recent years, much emphasis has been placed on gaseous losses of nitrogen and perhaps too little on residual soil nitrogen. Immobilization may often tie-up much nitrogen, perhaps 10 to 20 percent of that added as fertilizer. Most of this nitrogen, not lost by leaching during the following winter, will be available for the use of subsequent crops. If the climate and cropping system favor rapid mineralization of the immobilized nitrogen when there is no crop present to utilize the nitrates being formed, then there may be little recovery of this residual nitrogen.

Questions are asked as to the efficiency in terms of nitrogen recovery in the crop of various sources of commercial fertilizer nitrogen. Each situation must be considered individually. All of the common readily available commercial sources of nitrogen are likely to be nearly equally efficient if they are properly applied, and if due consideration is given to their individual properties. Highest efficiency may be expected if they are applied at the right time and at the right rate so that the crop can use them rapidly and completely.

SWCRD, ARS, USDA, Beltsville, Md.

Robinson, J. B. D., and Gacoka, P. EVIDENCE OF THE UPLAND MOVEMENT OF NITRATE DURING THE DRY SEASON IN THE KIKUYU RED LOAM COFFEE SOIL. J. Soil Sci. 13: 133-139. 1962.

Evidence shows that an upward movement of nitrate takes place in the Kikuyu red loam coffee topsoil during the hot, dry season following the main rain periods. This upward movement contributes towards the buildup of nitrate which takes place in the topsoil as it dries out.

Coffee Res. Sta., Lyamungu, Moshi, Tanganyika.

Volk, G. M. GASEOUS LOSS AND MOBILITY AS FACTORS IN NITROGEN EFFICIENCY. Soil and Crop Sci. Soc. Fla. Proc. 21: 261-268. 1961.

The leaching loss of nitrogen takes place primarily in the form of nitrate. Except for periods of continuous or heavy rainfall, extensive loss occurs only from fallow soils, or during crop dormancy, or with new crops before an extensive and efficient root system is developed. Mobility and loss by leaching of urea or ammonical nitrogen may be significant in some instances, but, in general, loss of nitrogen in these forms may be disregarded in predicting nitrogen efficiency.

Apparently, gaseous loss of nitrogen is significant, and to the extent that this loss represents ammonia it is possible to improve nitrogen efficiency by selection of materials and adjustment of cultural practices. Nitrogen top dressed on tilled crops should be covered. Ammonium nitrate is preferable to either urea or ammonium sulfate for application to turf immediately following top-dressed lime. Urea is the least preferable even on non-limed turf unless wetted in, as would be possible for ornamental turfs. Sources carrying only nitrate will deserve close study as top dressing for turf when and if they become competitive in cost per pound of nitrogen.

U. Fla., Fla. Agr. Expt. Sta., Gainesville, Fla.

## Soil Biology

Greenland, D. J., Lindstrom, G. R., and Quirk, J. P. ORGANIC MATERIALS WHICH STABILIZE NATURAL SOIL AGGREGATES. Soil Sci. Soc. Amer. Proc. 26: 366-371. 1962.

The effect of periodate followed by sodium borate treatment on the stabilities of prewet soil aggregates was determined by a permeability technique and by wet sieving. The effect of periodate treatment depended on the history of the site, the depth, and the great soil group from which the sample was taken. The stabilities of aggregates from various Red Brown Earths were all reduced by periodate treatment. The reduction was small for samples from plots which had been under pasture for many years, but was very large for samples which had been under pasture for 4 years or less, or which were continuously cropped. The stabilities of all subsurface samples of the Red Brown Earths were completely destroyed by periodate treatment. Aggregates taken from a Solonized Brown Soil were much less sensitive to periodate treatment, and those taken from a Rendzina were with one exception unaffected. These soils contain free  $\text{CaCO}_3$ . It is probable that the most important function of the periodate treatment is to cause breakdown of the polysaccharides and polyuronides in the soil, and the results show that in cropped soils and soils under young pastures aggregate stability is primarily due to these materials. In soils under older pastures, or soils which contain free  $\text{CaCO}_3$ , other materials prevent aggregate breakdown.

Waite Agr. Res. Inst., U. Adelaide, South Australia.

Allison, F. E., and Klein, C. J. RATES OF IMMOBILIZATION AND RELEASE OF NITROGEN FOLLOWING ADDITIONS OF CARBONACEOUS MATERIALS AND NITROGEN TO SOILS. Soil Sci. 93: 383-386. 1962.

In laboratory experiments conducted in soils, maximum immobilization of nitrogen by microorganisms decomposing wheat straw occurred in 20 days and averaged 1.7 percent of



the original weight of straw. This corresponds to a C:N ratio of 25.1. Nitrogen immobilization paralleled closely the rate of CO<sub>2</sub> evolution. Immediately following maximum nitrogen tie-up, mineralization became dominant and nitrogen release occurred. At the end of 75 days from the start of the experiment, immobilized nitrogen had decreased to 1.1 percent, and the residual material had a C:N ratio of approximately 13.

Published data of a similar type, where sucrose was the energy source, show that in 2 days the microorganisms immobilized 3.7 to 4.4 percent nitrogen (C:N ratio = 11.3 to 8.3) based on the weight of added sugar. A third of this nitrogen was released within 2 weeks, leaving residual material which had a C:N ratio of 6.2.

Nitrogen requirement in the utilization of carbonaceous materials depends on the composition of the material; on environmental conditions which affect the nature of the flora and the rate of decay; and on the time of incubation. Failure to give adequate consideration to the time factor accounts for much of the variation in reported nitrogen-requirement values.

SWCRD, ARS, USDA, Beltsville, Md.

Nömmik, H. MINERAL NITROGEN IMMOBILIZATION AND CARBON DIOXIDE PRODUCTION DURING DECOMPOSITION OF WHEAT STRAW IN SOIL AS INFLUENCED BY TEMPERATURE. *Acta Agr. Scandinavica* 12: 81-94. 1962.

Incubation experiments were made to study the influence of temperature upon the rate of decomposition of wheat straw and its relationship to the immobilization and remineralization of nitrogen in soil. The experiments were run at three different temperatures (5°, 12°, and 24°C.) and with and without addition of straw and mineral nitrogen.

Both the rate of decomposition of straw and the immobilization of inorganic nitrogen were highest at 24° C., and decreased rapidly with the temperature. The addition of nitrate nitrogen increased the mineralization of the straw carbon at all temperatures, but the nitrogen effect was most striking and appeared earliest at the highest incubation temperature. The maximum amounts of mineral nitrogen which were immobilized during the decomposition were at 5°C. 11.2 mg., at 12°C., 13.0 mg., and at 24°C., 14.7 mg. N per g. of straw (the total nitrogen content of the straw was 0.301 percent). In the temperature interval of 5-12°C. a nitrogen application of 4 kg. per ton of straw was sufficient to attain the maximum rate of decomposition. The addition of still higher amounts of mineral nitrogen caused an increased immobilization, without increasing significantly the rate of carbon dioxide production.

At 24°C. the positive effect of the mineral nitrogen addition on the straw carbon mineralization was most pronounced during the first 4 weeks of incubation. At the close of the experiment, after 29 weeks of incubation, the differences between the different treatments as to the amounts of carbon mineralized were negligible.

During the early periods of decomposition, there existed a clear positive correlation between the carbon dioxide production and the net immobilization of inorganic nitrogen.

The practical consequences of the influence of temperature upon the need for fertilizer nitrogen after plowing under large amounts of unrotted straw in the autumn were discussed.

Inst. General and Inorganic Chem. and Natl. Agron. Expt. Sta., Royal Agr. Col., Uppsala, Sweden.

Tuzimura, K., and Watanabe, I. THE EFFECT OF RHIZOSPHERE OF VARIOUS PLANTS ON THE GROWTH OF RHIZOBIUM: III. ECOLOGICAL STUDIES OF ROOT NODULE BACTERIA. *Soil Sci. and Plant Nutr.* 8: 153-157. 1962.

Numbers of clover bacteria (Rhizobium trifolii) in the rhizosphere of various crops were counted by the nodulation dilution frequency method using crimson clover as the test

plant. Numbers of aerobic bacteria and thermostable spores were also counted by agar plate method.

The growth of Rhizobium trifolii was stimulated in the rhizosphere of host plant (ladino clover and crimson clover), non-host leguminous plants (lucerne, common vetch, soybean, and peanut) and non-leguminous dicotyledonous plants (rape and tomato).

The density of clover bacteria in the rhizosphere soil of gramineous crops (upland rice, wheat, and Sudangrass) was lower than that in other plant rhizosphere soils.

U. Tokyo, Tokyo, Japan.

Young, J. L. INORGANIC SOIL NITROGEN AND CARBON:NITROGEN RATIOS OF SOME PACIFIC NORTHWEST SOILS. Soil Sci. 93: 397-404. 1962.

Inorganic N in relation to both total N of individual horizons and total N of the whole profile was examined for 17 Pacific Northwest soils. The influence of inorganic N on soil C/N ratios was also considered and compared with similar information on some north central United States soils. The author concluded:

1. Inorganic N as a fraction of total N in individual horizons varied from 1.7 to 47.2 percent. As a fraction of the total soil nitrogen reservoir (whole profile), mineral N constituted from 2.3 to 19.7 percent (two-thirds of 26 soils contained 10 or more percent mineral N). A Pierre-Promise soil of South Dakota held 48 percent of its total N as indigenous fixed  $\text{NH}_4^+$ . If soils are regarded as more than surface horizons, the data suggest that "about 80 to 98 percent of the total N exists in organic combination".
2. Mineral N was found largely as indigenous fixed  $\text{NH}_4^+$ , but exchangeable  $\text{NH}_4^+$  was the dominant mineral form in some Pacific Northwest soils.
3. Accounting for mineral N generally had little effect on C/N ratios of surface soil horizons, but markedly increased C/N ratios of subsurface horizons.
4. The distribution of organic C/organic N ratios varied from 4.5 to 20.9 with more values outside the range 8.5 to 11.4 than in it.
5. The C/N ratios of Pacific Northwest soils were generally a few units higher, and a smaller proportion were in the range less than 8.5, than north central United States soils.

SWCRD, ARS, USDA, Corvallis, Oreg.

Goring, C. A. I. CONTROL OF NITRIFICATION BY 2-CHLORO-6-(TRICHLOROMETHYL) PYRIDINE. Soil Sci. 93: 211-218. 1962.

The basic biological activity of 2-chloro-6-(trichloromethyl) pyridine in soils was studied. The results show it to be highly toxic to the organisms converting ammonium to nitrite, and to have a low order of toxicity to: (1) The organisms or enzyme converting urea to ammonia; (2) the organisms converting nitrite to nitrate; (3) the general fungus and bacterial populations; and (4) the seedlings of many plants.

In moist soil the chemical is highly sorbed by organic matter but not appreciably sorbed by the clay fraction of the soil.

The minimum concentration in soil required to delay the conversion of ammonium to nitrite for at least 6 weeks ranges from as low as 0.05 p.p.m. to as high as 20 p.p.m. Increasing concentrations delay conversion for longer periods of time. The chemical appears

to kill the organisms responsible for the conversion. After the concentration of the chemical in the soil becomes reduced to a non-toxic level, the interval required for recovery of the nitrifying organisms decreases with increasing pH, organic matter, reinfestation, and temperature.

Dow Chemical Co., Seal Beach, Calif.

Goring, C. A. I. CONTROL OF NITRIFICATION OF AMMONIUM FERTILIZERS AND UREA BY 2-CHLORO-6-(TRICHLOROMETHYL) PYRIDINE. Soil Sci. 93: 431-439. 1962.

Control of nitrification of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{HPO}_4$ , urea, and aqua ammonia treated with 2-chloro-6-(trichloromethyl) pyridine and applied to soils under simulated field situations was studied. Only partial control of nitrification was obtained.

The lowest effective concentration of chemical, expressed as a percent of the ammonium or urea nitrogen in the fertilizer source, was at least 2 percent for broadcast applications and at least 0.125 percent for band applications, except for aqua ammonia in which the chemical was effective at 0.125 to 0.5 percent.

Similar control of nitrification of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{HPO}_4$ , and urea was obtained in broadcast and band applications, except when leaching conditions occurred immediately after fertilizer application. In this situation, control of nitrification of urea was somewhat inferior to control of nitrification of the other fertilizers.

Control of nitrification in spot, band, and broadcast applications occurred in all of the soils tested, but there was variation in effectivity of the chemical.

The chemical was effective at all rates of application of water used in conjunction with broadcast and band fertilizer applications. Increasing rates of water application sometimes decreased the effectivity of the chemical.

Significant decreases in effectivity of the chemical caused by volatilization occurred: (1) When there was a substantial interval between broadcast applications of the treated fertilizer on the soil surface and initiation of water application; and (2) when a band application of the treated fertilizer was placed too close to the surface of the soil.

Dow Chemical Co., Seal Beach, Calif.

Hofer, A. W., and Crosier, W. F. PREINOCULATED ALFALFA SEED. Agron. J. 54: 97-100. 1962.

During the winter of 1959-60, three comparisons were made at 5-week intervals between lots of preinoculated seed and others that had been freshly inoculated with a commercial inoculant. The effect of fungicidal protectants upon the performance of the two brands of inoculant was also investigated.

Fungi with a high degree of pathogenicity, Fusarium equiseti and F. roseum, were present on some of the seeds and killed the developing seedlings. Both Fusarium spp. were isolated and the pure cultures proved to be pathogenic.

These fungi were evidently further distributed among the seeds by the moistening and mixing of the inoculation process. This distribution seemed, possibly, to be greater where the moistening and mixing was part of the preinoculation process.

The fungi were destructive under conditions of high moisture and high temperature.

Preinoculated seed seemed to produce nodules as readily as seed that was freshly inoculated. One lot tested, said to have been "Noculized" a year before the tests began, was still capable of producing nodules.



Although the protectants, captan and thiram, seemed to have a slight inhibiting effect upon the number and size of nodules, this disadvantage was more than compensated for by the beneficial action of these agents.

N.Y. State Agr. Expt. Sta., Geneva, N.Y.

Clapp, C. E., Davis, R. J., and Waugaman, S. H. THE EFFECT OF RHIZOBIAL POLYSACCHARIDES ON AGGREGATE STABILITY. Soil Sci. Soc. Amer. Proc. 26: 466-469. 1962.

Sixteen rhizobial polysaccharides previously isolated and characterized and representing several cross-inoculation groups were screened for aggregate stabilization effects on 10 subsoils of widely varying properties. Two additional polysaccharides of bacterial origin and three chemical compounds were included for comparison with the rhizobial products.

Artificial aggregates were prepared in acrylic plastic molds under standardized moisture conditions. An ethanol-water microslaking procedure for assessing stability was used to determine relative effects between aggregating agents and soils. At the low concentrations used, several rhizobial polysaccharides were more effective stabilizing agents on most soils than either the synthetic soil conditioner or the other reference compounds. Some general comparisons relating carboxyl content and viscosity of the rhizobial polysaccharides and clay content with aggregate stabilization are presented and discussed.

SWCRD, ARS, USDA, St. Paul, Minn.

## Soil-Plant-Animal Relationships

Brown, J. C., and Tiffin, L. O. ZINC DEFICIENCY AND IRON CHLOROSIS DEPENDENT ON THE PLANT SPECIES AND NUTRIENT-ELEMENT BALANCE IN TULARE CLAY. Agron. J. 54: 356-358. 1962.

Tulare c serves to demonstrate the importance of nutrient-element balance in plant nutrition and soil management. Red kidney beans, okra, tomatoes, dill, cotton and corn developed zinc deficiency on this soil. Barley, wheat, Hawkeye soybeans, and millet developed no deficiency symptoms. Zinc deficiency was related to a plant's capacity to absorb zinc from the soil.

PI-54619-5-1 soybean and Sericea lespedeza developed iron chlorosis on both the zinc-treated and untreated soil. Zinc added to the soil induced an iron chlorosis in corn and millet but did not do this in the other plant species. Increasing additions of phosphorus accentuated both zinc deficiency and iron chlorosis.

The future productivity of Tulare c will depend largely on soil management practices related to nutrient-element balance.

SWCRD, ARS, USDA, Beltsville, Md.

Bhan, K. C., Wallace, A., and Krohn, E. J. EFFECT OF pH AND NITROGEN SOURCE ON THE ABILITY OF CORN AND SOYBEAN TO OBTAIN IRON CHELATED WITH ETHYLENEDIAMINE DI(O-HYDROXYPHENYLACETATE). Agron. J. 54: 119-121. 1962.

Hawkeye and PI 54619-5-1 soybeans and Pioneer 352 corn were grown in solution culture with nitrate vs. ammonium nitrogen sources and at different pH values. Fe was supplied

as FeEDDHA (Ethylenediamine di(o-Hydroxyphenylacetate). Unless severely chlorotic, the soybeans produced more dry matter at pH 7 and 8 than at pH 4 regardless of the nitrogen source, but the effect on the corn was reversed. The effect with corn may have been partly the result of Fe deficiency, in that less Fe from FeEDDHA was absorbed at the high pH. The PI 54619-5-1 soybeans also had Fe deficiency at high pH. The Hawkeye soybeans at pH 4 were much more sensitive to  $\text{NH}_4^+$  -N than were the PI 54619-5-1 soybeans. The yield differences for soybeans could not be explained by the inorganic analyses except for Fe content in plants grown at pH 8.

U. Calif., Los Angeles, Calif.

MacKay, D. C., Langille, W. M., and Chipman, E. W. BORON DEFICIENCY AND TOXICITY IN CROPS GROWN ON SPHAGNUM PEAT SOIL. *Canad. J. Soil Sci.* 42: 302-310. 1962.

Eight crops were grown in greenhouse experiments on limed and fertilized sphagnum peat soil treated with various rates of borax. All crops, including beans and potatoes which have low requirements, gave marked response to borax when none was present in the chemicals used for correcting soil acidity. Commercial lime apparently provided sufficient boron as an impurity to reduce the response considerably.

Boron levels accumulating from successive applications were toxic to sensitive crops like oats and beans only when heavy rates had been applied. With cabbage, a tolerant crop, the heaviest rate of 600 pounds/acre, applied over a 4-year period, gave no indication of toxicity.

Boron deficiency was alleviated and maximum crop yields were obtained at water-soluble soil boron concentrations ranging from 1.5 p.p.m. for beans to 2.8 p.p.m. for lettuce. Toxicity symptoms were apparent at soil levels extending from 4.8 p.p.m. for oats to > 11 p.p.m. for cabbage.

Minimum sufficiency concentrations in the plant tissue varied from 12 p.p.m. in beans and potatoes to 32 p.p.m. in spinach. The lowest values associated with toxicity extended from 105 p.p.m. in oats to > 200 p.p.m. in cabbage.

Contribution 1106, Res. Sta., Canada Dept. Agr., Kentville, Nova Scotia, Canada.

Embleton, T. W., Labanauskas, C. K., and Bitters, W. P. THE INFLUENCE OF CERTAIN ROOTSTOCKS ON THE CONCENTRATION OF BORON, IRON, MANGANESE, AND OTHER ELEMENTS IN LEMON LEAVES, AND ON BORON TOXICITY SYMPTOMS. *Proc. Amer. Soc. for Hort. Sci.* 80: 285-290. 1962.

Alemow (*Citrus macrophylla*) rootstock with Frost Nucellar Eureka lemon scions resulted in a lower concentration of B in the leaves and a lower incidence of B-toxicity leaf symptoms than did Rutherford sweet orange (*Citrus sinensis*), Nanshō daidai (*C. taiwanica*), Rangpur lime (*C. limonia*), Yuzu (*C. junos*), Royal grapefruit (*C. paradisi*), Gajanimma (*C. pennivesiculata* or *C. Moi*), Sauvage sour orange (*C. Aurantium*), and Oklawaha sour orange (*C. Aurantium*). Alemow rootstock induced a relatively high Mn level and a relatively low level of Mg in scion leaves.

Yuzu rootstock resulted in substantially higher concentrations of Mn, Fe, and Na, and lower Ca in scion leaves than did the other evaluated in areas where Fe and Mn deficiencies are problems, but use of this rootstock may be open to question where high Na is a problem.

Citrus Res. Cent. and Agr. Expt. Sta., U. Calif., Riverside, Calif.

Areas in Indiana were studied to determine where molybdenum deficiencies are a limiting factor in crop production. Where should molybdenum responses be expected?

1. Acid soils tend to tie up molybdenum and may be low.
2. In sandy soils some of the molybdate salt may be lost by leaching.
3. Soils that have been heavily cropped, especially in areas where hay is sold off the farm, would be low because of crop removals.

Plant and soil samples were taken from 5 soybean fields on each of 19 different soil types in Indiana. A molybdenum analysis was made of the aboveground portion of the soybean plant. The results are summarized in the following table.

TABLE

The effect of soil type on the molybdenum content of the soil and the soybean plant growing on the soil.  
Total molybdenum content (PPM) \*

Soil Type	Plant		Soil
	Ave.	Range	
Odell silt loam .....	0.47	0.06-1.12	2.08
Vigo silt loam .....	0.57	0.10-1.19	2.48
Chalmers silty clay loam .....	0.60	0.42-0.67	1.52
Fincastle silt loam.....	0.65	0.37-0.75	
Door silt loam.....	0.80	0.02-1.60	
Plainfield loamy fine sand .....	0.83	0.42-1.08	
Newton loamy sand.....	0.98	0.62-1.75	
Fox silt loam .....	1.13	0.74-1.58	
Tracy fine sandy loam .....	1.24	0.44-2.42	
Alford silt loam.....	1.25	0.82-1.75	
Crosby silt loam.....	1.49	0.42-1.91	1.77
Cincinnati silt loam.....	1.59	1.08-2.62	
Granby fine sandy loam.....	1.77	0.28-4.26	1.47
Brookston silty clay loam.....	1.98	0.75-3.86	
Maumee sandy loam .....	2.42	0.15-8.82	
Hoytville silty clay loam .....	3.37	1.68-4.85	3.05
Nappanee silt loam.....	3.57	1.45-6.94	4.29
Carlisle muck .....	5.85	0.42-14.34	23.20
Genesee silt loam .....	6.39	1.55-21.25	2.56

\* Plant molybdenum analyses include five samples grown on each soil. Results from soil analyses include duplicates on one to three soils. Only one Carlisle muck sample has been analyzed.



Alben, A. O. EVALUATION OF ZINC CHELATE AND ZINC SULFATE SPRAYS FOR CONTROLLING ROSETTE ON SCHLEY AND STUART PECANS. Proc. Amer. Soc. for Hort. Sci. 80: 312-314. 1962.

Rosetted Schley and Stuart pecan trees in an east Texas orchard were sprayed with solutions of zinc chelate (disodium zinc salt of ethylene diamine tetra acetic acid, 14.2% zinc) at concentrations of 1/2, 1, 2, and 3 lb./100 gallons of water or with 36% zinc sulfate at the rate of 2 lb./100 gallons of water on May 10 and again on May 24, 1960.

A few moderately rosetted Schley trees and several similarly affected Stuart trees recovered completely from rosette after application of sprays containing the higher concentrations of zinc. None of the severely rosetted trees recovered completely. Recovery was somewhat proportional to the concentration of the zinc chelate in the sprays. Zinc sulfate at 2 lb./100 gallons of water ranked second for each variety in effecting recovery from rosette. Two spray applications failed to completely control rosette on severely affected trees.

CRD, ARS, USDA, Shreveport, La.

Harding, R. B., Ryan, T. M., and Bradford, G. R. A COMPARISON OF THE MACROELEMENT COMPOSITION OF ORANGE LEAVES FROM NONFRUITING AND FRUITING TERMINALS. Proc. Amer. Soc. for Hort. Sci. 80: 255-258. 1962.

A comparison was made between the macroelement content of orange leaves 4 to 6 months of age taken from nonfruiting and fruiting terminals of the same trees. The study included 22 representative orange orchards of California.

Highly significant larger amounts of N, K, P, and S were found in leaves from nonfruiting terminals, while highly significant larger amounts of Ca, Mg, and Cl were found in leaves from fruiting terminals. No significant differences were found in the amounts of Na.

The results indicate that sampling from nonfruiting or fruiting terminals in orange orchards is an important factor to consider when using leaf analysis as a guide to the nutritional status of the trees.

U. Calif., Citrus Res. Cent. and Agr. Expt. Sta., Riverside, Calif.

Bramlage, W. J., and Thompson, A. H. THE EFFECTS OF EARLY-SEASON SPRAYS OF BORON ON FRUIT SET, COLOR, FINISH, AND STORAGE LIFE OF APPLES. Proc. Amer. Soc. for Hort. Sci. 80: 64-72. 1962.

Jonathan, Stayman, and Golden Delicious apple trees were sprayed early in the season with B. Spray treatments resulted in only a temporary increase of B concentration in the leaves, but an increase in B concentration in fruits persisted throughout the season. Fruit set of Stayman was increased but not that of Jonathan or Golden Delicious. Spray treatments retarded the development of Jonathan spot. Multiple sprays of B increased internal breakdown of Jonathan fruits during storage and increased water core of Jonathan fruits in the orchard and during storage.

B spray treatments had no effect on fruit color or finish, decay or scald during storage, or firmness, moisture content, total sugars, and alcohol-insoluble solids.

U. Md., College Park, Md.

## Soil Classification

Hauser, G., Reckendorf, F., and Smith, D. GEOMORPHOLOGY AND QUATERNARY HISTORY OF SHELL VALLEY, BIGHORN COUNTY, WYOMING. Iowa Acad.Sci. Proc. 68: 404-415. 1961.

Shell Valley, from the mouth of Shell Canyon, to its junction with the Bighorn River in east-central Bighorn County, Wyoming, was mapped and the fluvial landforms were described in detail. The morphologic features of this valley and its major tributaries are largely the product of structurally controlled stream erosion and alluviation. Their disposition indicates that they have been produced by lateral planation, slope retreat, simple downcutting, and downcutting accompanied by lateral migration of the stream, all of which are still active. Correlation of the local features with some more regional features, which have been dated, indicates that much of the erosional history of Shell Valley was confined to the Pleistocene.

Address not given.

Parsons, R. B., Scholtes, W. H., and Riecken, F. F. SOILS OF INDIAN MOUNDS IN NORTH-EASTERN IOWA AS BENCHMARKS FOR STUDIES OF SOIL GENESIS. Soil Sci. Soc. Amer. Proc. 26: 491-496. 1962.

The degree of horizon development in seven prehistoric Indian mounds of known age in northeastern Iowa was evaluated. Comparisons were made between the data obtained for the Indian mound soil profiles and two virgin, loess-derived Fayette profiles from the landscape near the mounds. The parent materials for the mound soils were the leached upper horizons of the soils under and immediately adjacent to the mounds.

Morphologically, the mound profiles exhibited pronounced A<sub>1</sub> horizons, weak color and structural A<sub>2</sub> horizons, and incipient B horizons. Differences in profile development among the mounds were attributed to differences in mound age. The development of soil profiles in the mounds has been the most pronounced during the first 1,000 years. The mounds have reached their greatest present horizon expression in a period of no more than 2,500 years, and are similar in many respects to the Fayette soils which have developed over a period of no more than 14,000 years.

SCS, USDA, Oreg. State U., Corvallis, Oreg.

Dapples, E. C. STAGES OF DIAGENESIS IN THE DEVELOPMENT OF SANDSTONES. Geol. Soc. Amer. B. 73: 913-933. 1962.

On the basis of mineral replacements and intergrowths, four oxide series are recognized among sandstones: (1) Alumina, lime-magnesia, iron oxide; (2) silica, lime-magnesia, iron oxide; (3) silica, alumina, iron oxide; and (4) silica, alumina, lime-magnesia. Typical reactions are: For series (1), hematite + calcite + Mg.  $\rightleftharpoons$  siderite + ferrodolomite + domomite; for series (2), hematite + clay minerals + silica  $\rightleftharpoons$  chlorite + greenalite; for series (3), diaspore + silica  $\rightleftharpoons$  clay minerals, and diaspore + silica + K  $\rightleftharpoons$  glauconite + clay minerals; also, during late burial illite + Na + K + Ca  $\rightleftharpoons$  muscovite + biotite + feldspar; for series (4), illite or glauconite  $\rightleftharpoons$  chlorite + muscovite; and calcite + Mg + illite  $\rightleftharpoons$  micas + feldspar + dolomite; also, with deep and late burial, clay minerals  $\rightleftharpoons$  chlorite or sericite, K feldspar  $\rightleftharpoons$  sericite, plagioclase  $\rightleftharpoons$  chlorite + chert.

From the type of reaction and the principal sequence of occurrence three stages of diagenesis are established: Stage (1), redoxomorphic, which dominates the episodes of deposition and early burial. Reactions principally are reduction and oxidation which form the basis for the name of the stage. Stage (2), identified as locomorphic, involves replacement of one mineral by another, the two minerals not entering into mutual reaction. Such reactions are typical of the early burial stage and are an important part of the process of lithification. Stage (3), identified as phylломorphic, follows the principal locomorphic replacements and involves development of micas, principally from clays.

Among sandstones, the progress of diagenesis may be arrested at either the locomorphic or phylломorphic stages, in more or less parallel fashion to metamorphic grades. Also, the phylломorphic stage overlaps the zeolite and chlorite grades of metamorphism.

Northwestern U., Evanston, Ill.

Bourne, W. C., and Whiteside, E. P. A STUDY OF THE MORPHOLOGY AND PEDOGENESIS OF A MEDIAL CHERNOZEM DEVELOPED IN LOESS. Soil Sci. Soc. Amer. Proc. 26: 484-490. 1962.

Bozeman sici is a well-drained, medial northern Chernozem. The A horizons are very dark grayish brown and granular; the B horizons are dark grayish brown to dark brown and compound prismatic-blocky; and the C horizons are calcareous, pale brown, massive silt loams. Particle-size distributions of the associated loess deposits indicated that local flood-plains contributed significantly to their silt and sand fractions, and that some stratification must have occurred during their deposition. During pedogenesis, marked changes have occurred in the microfabric of the soil, and acid-soluble material, mostly lime, has been moved into and through the C<sub>ca</sub> horizon. The principal clays are montmorillonite and illite. During pedogenesis, there has been an increase in total clay in the solum, a movement of some clay downward, and a reconstitution of much of the clay of the A horizons to randomly interstratified forms. Calculations show the relative rate of clay formation to be highest in the lower A horizon.

Jr. Author, Mich. Agr. Expt. Sta., East Lansing, Mich.

Damman, A. W. H. DEVELOPMENT OF HYDROMORPHIC HUMUS PODZOLS AND SOME NOTES ON THE CLASSIFICATION OF PODZOLS IN GENERAL. J. Soil Sci. 13: 92-97. 1962.

Hydromorphic humus podzols can develop under submerged conditions as a result of internal water movement, and their development is by no means dependent on the occurrence of a water table which descends, periodically, below the B horizon. The basic difference between podzolization under anaerobic and aerobic conditions is stressed, and it is suggested that classification of the podzols be based in the first place on these two processes, using the humus content of the B horizon for a further subdivision. The humus content of the B horizon is unsuitable for the primary subdivision since it is governed by a number of independent factors.

Dept. Forestry, St. John's, Newfoundland, Canada.



Bhattacharya, N. WEATHERING OF GLACIAL TILLS IN INDIANA: I. CLAY MINERALS. Geol. Soc. Amer. B. 73: 1007-1020. 1962.

X-ray diffraction data indicate that profiles developed on Wisconsin, Illinoian, and Kansan tills in Indiana differ from each other with respect to the stages attained in clay-mineral alteration. The post-Wisconsin weathering profile is distinctly different from the buried profiles on Illinoian and Kansan tills, but the differences are not quite so great between the weathering profiles developed during the Sangamon age on Illinoian tills and those of Yarmouth age on Kansan tills.

Hydration and ionic exchanges produce major changes in clay-mineral alteration, but oxidation, hydrolysis, polymerization, and recrystallization also play significant roles. The final alteration products of clay minerals are determined by the composition of the original clay and the duration of alteration.

Oil and Natural Gas Comn., Dehra Dun, India.

Ray, B. W., and Watters, P. S. CHARACTERISTICS AND IMPLICATIONS OF A THIN LOESS AREA IN NORTHWESTERN ILLINOIS. Ill. State Acad. Sci. Trans. 54: 136-144. 1961.

An unusual area of thin loess in southwestern Carroll and northwestern Whiteside Counties in Illinois was delineated. A detailed map is given showing soil parent materials of the thin loess area in Carroll County.

Soil profile morphology in this area reflects the variability of the drift. Some profiles in till suggest the presence of youthful material while others indicate the presence of a paleosol which has been truncated and recently covered with thin loess deposits. Water-deposited sandy material occurs commonly in the area.

Loess thickness in this area suggests ice occupancy at a much later date than the area to the north and east. This occurred as a northwesterly extension of the Tazewell drift described by Shaffer (1954 and 1956) to a point southeast of Savanna. The deposits of this ice occur in a patchy pattern as till and waterlaid material.

The drift directly adjacent to the thin loess area to the north and east, except on the steepest slopes, is covered by Farmdale loess and thick deposits of Peorian loess. The profile developed in till below Farmdale loess suggests an age older than classic Farmdale.

Many questions remain unanswered in this area, but pedologic evidence strongly suggests the thin loess area can best be explained by ice occupancy of the area which prevented loess deposition until post-Tazewell time.

U. Ill., Urbana, Ill.

Wallace, R. W., and Handy, R. L. STONE LINES ON CARY TILL. Iowa Acad. Sci. Proc. 68: 372-379. 1961.

Stone lines occur as layers or sheets of stones on the Cary drift plain in central Iowa. One occurrence is along drainageways and seems to be reflected in the present landscape by nearly flat surfaces. A map of an area in Boone County, Iowa, is presented, showing the distribution of the surfaces, and sections along 2 traverses on 1 of the surfaces are shown. Engineering and pedologic significance and some of the proposed origins are discussed. Particle size data indicate that material overlying the stone line becomes gradually coarser and thinner downslope, in contrast to the trend observed in swales.

Iowa State U., Ames, Iowa.

Litchfield, W. H., and Mabbutt, J. A. HARDPAN IN SOILS OF SEMI-ARID WESTERN AUSTRALIA. J. Soil Sci. 13: 148-159. 1962.

Hardpan cemented by silica occurs widely in semiarid Western Australia below a variety of soils, mainly at shallow depth but more deeply in more permeable soils.

Strongly cemented hardpan is widespread on gentle alluvial slopes formed by partial destruction of a lateritized Tertiary land surface; it also occurs in sand plain or remnants of this surface, but occurs only locally in the saline alluvial plains in the lowest areas of interior drainage.

Hardpan results from silica cementation and clay deposition. As suggested by Teakle (1936), it may be due to leaching following episodic sheet flooding. Its formation appears to have kept pace with deposition of alluvium, and continues at the present time. Irregularities in or absence of hardpan formation relate to changes of slope, local drainage, and to certain soils.

Div. Soils Commonwealth Sci. and Indus. Res. Organ., Adelaide, South Australia.

Clarke, G. R. THE PREPARATION AND PRESERVATION OF SOIL MONOLITHS OF THIN SECTION. J. Soil Sci. 13: 18-21. 1962.

Techniques are described for the preparation and mounting of soil monoliths with a depth of 1-1.5 in. The material is fixed with cellulose acetate and mounted in a way suitable for permanent exhibition. The preparation and preservation of hand specimens of special fragments are described.

A piece of five-ply board, 6 in. wide and of the required length (normally units of 24 in.), is prepared and around this is fitted a frame (0.5 by 1.5 in.) to form a tray of overall width of 7 in. and an internal depth of 1.0 in.

Dept. Agr., U. Oxford, Oxford, England.

Muir, J. W., and Hardie, H. G. M. A PUNCHED-CARD SYSTEM FOR SOIL PROFILES. J. Soil Sci. 13: 249-253. 1962.

A punched-card system, designed to make data on a large number of profiles readily available, is described. The problems of converting the data to a form suitable for punching on the card are fully discussed. A numerical code is used to group the profiles according to soil series, major soil group, or geographical location. Analytical results of various kinds are also coded for each major horizon. A feature of the system is that information on a complete profile is coded on one card so that the profile remains the basic unit.

Macaulay Inst. Soil Res., Aberdeen, Scotland.

Muir, J. W. THE GENERAL PRINCIPLES OF CLASSIFICATION WITH REFERENCE TO SOILS. J. Soil Sci. 13: 22-30. 1962.

Natural and artificial systems of classification are defined. One of the most advanced natural systems of classification is the Periodic Classification of the Elements and its development is traced so that it can be used as a framework of reference for other systems of classification, in particular those for plants and soils. Plant classification is a mature

system, but soil classification is still in an elementary stage of development. The strengths and weaknesses of two recently published systems, the Soils of Europe by Kubiena and the 7th Approximation by the Staff of the U.S. Soil Survey, are discussed.

The author concluded that the future development of soil classification is not easy to predict. Both Kubiena's system and the 7th Approximation undoubtedly make valuable contributions, but they are unlikely to prove satisfactory even for immediate requirements in their present form. The former requires better specification, especially at lower levels, and the latter a more comprehensive and ordered treatment of the upper levels.

Macaulay Inst. Soil Res., Craigiebuckler, Aberdeen, Scotland.

Williams, D. A. CONSERVATION NEEDS IN A CHANGING AGRICULTURE. J. Soil and Water Conserv. 17: 51-54. 1962.

The National Inventory of Soil and Water Conservation Needs presents the best picture Americans have ever had of the United States' privately owned land and water resources and the size of the soil and water conservation job ahead. The Inventory will serve as a benchmark indicating present accomplishments and as a solid foundation for future basic soil and water resources planning on local, state, and national levels.

SCS, USDA, Washington 25, D.C.

Jewett, J. M. THE GEOLOGIC MAKING OF KANSAS. Kans. Acad. Sci. Trans. 64: 175-197. 1961.

A report on the geological formations in Kansas is presented.

Charts, tables, and maps.

Senior Geologist, The State Geol. Survey Kans.

Soil Conservation Service. SOIL SURVEY: \* U.S. Dept. Agr., Soil Conserv. Serv. \*\*

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Cullman County, Ala.	73 pp.	June 1962.
Kenai-Kasilof Area, Alaska.	56 pp.	June 1962.
Madera Area, Calif.	155 pp.	May 1962.
Merced Area, Calif.	131 pp.	July 1962.
Fraiser Alpine Area, Colo.	47 pp.	March 1962.
Hartford County, Conn.	126 pp.	Feb. 1962.
Scott County, Ind.	69 pp.	March 1962.
Van Buren County, Iowa.	86 pp.	Jan. 1962.
Acadia Parish, La.	57 pp.	Sept. 1962.
Bossier Parish, La.	144 pp.	Aug. 1962.
Sharkey County, Miss.	36 pp.	Feb. 1962.
Hall County, Nebr.	141 pp.	Jan. 1962.
Kimball County, Nebr.	74 pp.	March 1962.



Gloucester County, N.J.	84 pp.	June 1962.
Yadkin County, N.C.	74 pp.	Nov. 1962.
Clinton County, Ohio.	113 pp.	Sept. 1962.
Beaver County, Okla.	80 pp.	Aug. 1962.
Carbon County, Pa.	108 pp.	Nov. 1962.
Cherokee County, S.C.	105 pp.	July 1962.
Saluda County, S.C.	103 pp.	Aug. 1962.
Carson County, Tex.	69 pp.	July 1962.
Lumb County, Tex.	69 pp.	March 1962.
Terry County, Tex.	57 pp.	Feb. 1962.
Wilbarger County, Tex.	64 pp.	Sept. 1962.
San Juan Area, Utah.	49 pp.	Aug. 1962.
Mathews County, Va.	44 pp.	Nov. 1962.
San Juan County, Wash.	73 pp.	Nov. 1962.
Buffalo County, Wis.	103 pp.	March 1962.
Iowa County, Wis.	101 pp.	July 1962.

These Soil Surveys are all published by the United States Department of Agriculture, Soil Conservation Service in cooperation with the local State agricultural and/or other co-operating agencies. All contain maps in addition to written text.

SCS, USDA, Inform. Div., Washington 25, D.C.

## EROSION CONTROL

### Wind and Water Erosion

Allis, J. A., and Kuhlman, A. R. RUNOFF AND SEDIMENT YIELD STUDIES ON RANGE-LAND WATERSHEDS. J. Soil and Water Conserv. 17: 68-71. 1962.

A runoff and sedimentation research program was initiated in 1957 in the Northern Great Plains. Established at Newell, S.D., the project involves 16 grassland watersheds ranging in size from 30 to 13,000 acres. Data collected during a 3.5-year period show more than three times as much runoff from the fine-textured soils as from the medium-textured soils of the rangeland. Dissipation of stored water by evaporation, percolation, and seepage from reservoirs is significant.

The data being obtained on water and sediment yield are applicable in western South Dakota, southwestern North Dakota, northeastern Wyoming, and central and eastern Montana.

SWCRD, ARS, USDA, Hastings, Nebr.

Burwell, R. E. RUNOFF AND EROSION INVESTIGATIONS ON PLASTIC TILL SOIL OF NORTHEASTERN ILLINOIS. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-55, 23 pp. 1962.

The effects of row direction, nitrogen fertility level, and cropping system on runoff, soil and water losses and crop yield from a plastic till soil in northeastern Illinois were studied for 8 years.

The erosion potential for this study, computed as the product of rainfall energy and maximum 30-minute intensity of the storm, shows that the greatest amount of erosion can be expected to occur in June and July. The greatest daily erosion potential occurs in the crop-stage period of from 1 to 2 months after planting (usually June 15 through July 14).

Runoff and soil losses were generally lower than would be expected in the area. However, the plots were only 100 feet long and the soil condition sampled was undoubtedly less conducive to runoff and erosion than similar slopes in the area that had a more intensive cropping history.

The greatest water losses occurred in 1957 and 1958. Most of the runoff during the winter period was caused by melting snow and ice. The greatest average annual water losses during corn production occurred from 1 to 2 months after corn planting. Water losses were two times greater from corn farmed up and down the slope than from corn farmed on the contour.

On plots farmed to continuous corn for 5 years with a high nitrogen fertility level, the average annual soil loss was seven times greater from those plots farmed up and down the slope than from those farmed on the contour. Nitrogen fertility level did not affect soil losses. High productivity of both the high and low nitrogen fertility level resulted in the incorporation of large quantities of residues for the two treatments. Average annual soil losses from corn in the 3- and 4-year rotations were only slightly less than the soil losses from 5 years of continuous corn. Soil loss was greater from corn at the stage of crop growth from 1 to 2 months after planting than from other growth periods.

Highest yields were obtained from contour plots, high nitrogen level applications, and rotations that included legumes.

Tables, maps, and graphs.

ARS, USDA, Inform. Div., Washington 25, D.C.

Dean, T. M. SAFE WATER DISPOSAL ON OLD BELT TOBACCO FIELDS. J. Soil and Water Conserv. 17: 80-81. 1962.

Safe disposal of excess runoff from tobacco fields in the bright tobacco "Old Belt" in southern Virginia presents some difficult technical problems.

Bright tobacco, used mostly in cigarettes, is a high return crop averaging \$1,000 to \$1,400 per acre on the better soils of the region. Acreage grown on a farm is strictly allotted in units as small as a hundredth of an acre. The tobacco farmer is very sensitive about any soil management changes that could possibly adversely affect crop yields.

Tobacco is planted in hilled rows, cultivated in hills and "laid by" (cultivated for the last time) in hilled rows. The crop drowns easily; water standing in the rows for only a few hours will kill the plants. The hilled rows collect great quantities of runoff during intense rains, and although the land is gently sloping to rolling and the soils are predominantly deep fine sandy loams, runoff is particularly high when the intense rains come in May, June, and July.

A complete runoff control system cannot be expected to prevent all soil, water, and plant food losses from intensely cultivated tobacco fields, but with good grassed waterways in the right places, proper terracing, and correct row layout, these losses can be reduced to tolerable amounts.

SCS, USDA, Boydton, Va.

## Terraces

Hauser, V. L., and Cox, M. B. EVALUATION OF ZINGG CONSERVATION BENCH TERRACE. Agr. Engin. 43: 462-464, 467. 1962.

The Zingg conservation bench terrace is an improved terrace for the Great Plains. Zingg terraces control erosion the same way conventional terraces do, but they also conserve more runoff water than conventional terraces. Increased grain production is accompanied by increased crop residue production--an essential element in wind erosion control.

Increased yields on the benches depend on runoff water from the watersheds and potential runoff from the bench which is caught and stored in the soil. The Zingg terrace requires deep soil to store the runoff caught on the benches and also to allow the necessary cutting which accompanies land-leveling operations.

Five years after leveling, the bench areas stripped of topsoil at Bushland, Tex., had not recovered their original productive capacity by natural processes. Crop yields on unfertilized cut areas were 56 percent of yields on fill in 1957, and the same percentage yield difference was still observed in 1960. Field and greenhouse experiments show that production can be increased on cut-and-fill areas by applying commercial fertilizer. On the Zingg bench the factor which first limits crop production was changed from soil moisture to soil fertility. Therefore, to efficiently use stored runoff water, fertility deficiencies should be corrected.

Leveling precision should be as good as or better than that required for irrigation leveling. Good leveling precision aids uniform distribution of runoff water and surface drainage when that becomes necessary. Waterways are needed to dispose of excess water that cannot be impounded on the bench.

The ratio of watershed area to bench area is important information needed for the design of Zingg terraces. At Bushland the bench with no watershed produced little or no return on the land-leveling investment, but the two-to-one ratio utilized precipitation more efficiently.

Parallel terraces have gained favor among farmers in more humid regions and should be just as acceptable to Great Plains farmers. The Zingg conservation bench terrace lends itself to parallel systems on smooth land. It is necessary to move earth to construct the bench and would involve little more cost to make most of the system parallel. The bench area is a logical place to make the necessary cuts and fills associated with parallel terraces.

SWCRD, ARS, USDA, Bushland, Tex.

Buie, T. S. "WALKING" WATER DOWNHILL. Amer. Fruit Grower. 82(5): 44. 1962.

Progressive South Carolina orchardists are planting their new peach and apple orchards on the contour. The precise, straight-row arrangement--long considered essential for the efficient use of spray and cultivating equipment--is giving way to gently curving rows fitted against the side of the sloping hill.

Most South Carolina apple orchards are on steep hills in the shadow of the Blue Ridge Mountains. To have these rows follow "the lay of the land" requires skill, ingenuity, and practice.

Each terrace-row discharges its surplus water into grassed drains where the soil particles are strained out. The clear water finds its way slowly to the pond at the foot of the hill. From there it may be pumped back to the trees when irrigation is necessary.

SCS, USDA, Columbia, S.C.



## Critical Areas

Diseker, E. G., and Richardson, E. C. HIGHWAY EROSION RESEARCH STUDIES. Mimeo Rpt. for Presentation at the Twentieth Annual Short Course on Roadside Development at Columbus, Ohio, October 1961. 15 pp + 17 fig. 1961.

The rate of annual soil loss on bare road cuts and highway ditches reaches disturbing proportions. In addition to destroying natural beauty and creating unsightly scenery, this loss is a serious problem to agriculture, reservoirs, streams, and highway maintenance.

Adaptive plants on properly fertilized areas can develop an effective cover to control erosion on these areas. Mulches are essential for cover development on the steeper cuts and for plants that are slow in developing a complete cover.

Tables, graphs, and photographs.

SWCRD, ARS, USDA, Coosa Watershed Project, Cartersville, Ga.

Sawyer, L. E. MINED AREA RESTORATION IN INDIANA. J. Soil and Water Conserv. 17: 65-67. 1962.

Nearly 20,000 acres of land are being excavated each year in the United States for open-cut coal mining. New technological advances increase economic opportunities for obtaining coal through removal of the overburden of rock and soil. The problem of restoring spoil resulting from strip mining of coal to some form of productive use is becoming increasingly important. This definitive analysis of the problem and report of progress in Indiana was presented at a symposium sponsored by the Society's Mined Area Restoration Committee during the Sixteenth Annual Meeting of the Soil Conservation Society of America.

Mid-West Coal Producers Inst. Inc., Terre Haute, Ind.

Soil Conservation. 27(7): 147-167. 1962.

The February Issue of "Soil Conservation" is devoted to articles on Urban Development and Urban Conservation. The following is author, title, and address of author for each article presented:

1. Williams, D. A. RURBANIZATION A MAJOR CONSERVATION CHALLENGE. SCS, USDA, Washington 25, D.C.
2. Herbert, F. W. CALIFORNIA'S URBAN SPRAWL BRINGS CONSERVATION PROBLEMS. SCS, USDA, Berkeley, Calif.
3. Roth, B. A. SOIL SURVEYS HELP URBAN PLANNERS. SCS, USDA, Upper Darby, Pa.
4. Beard, J. E. VIRGINIA'S FAIRFAX COUNTY OUTSTANDING ON RURBAN ACTION. Fairfax County Extension Service, Falls Church, Va.
5. Archer, S. G. GEORGIANS MEET A RURBAN PROBLEM HEAD ON AND FAST. SCS, USDA, Spartanburg, S.C.
6. Lucas, W., and Krivak, J. A. NON-FARMERS IN PITTSBURGH AREA SEEK MOST CONSERVATION HELP. SCS, USDA, Pittsburgh, Pa.

7. Blickensderfer, C. B. GRASS ROTATIONS BOON TO VEGETABLE BUSINESS. SCS, USDA, Palmetto, Fla.
8. Smith, G. S. PUTS SEEP WATER TO WORK ALL AROUND THE HOUSE. SCS, USDA, Upper Darby, Pa.
9. Williams, D. A. REPORT OF THE ADMINISTRATOR, SOIL CONSERVATION SERVICE, 1961. SCS, USDA, Washington 25, D.C.

## SOIL MANAGEMENT

### Cropping Practices

Triplett, G. B., Jr. INTERCROPS IN CORN AND SOYBEAN CROPPING SYSTEMS. Agron. J. 54: 106-109. 1962.

Four field experiments were conducted over a period of 6 to 8 years to assess the concurrent and residual effects of intercrops in corn and soybean cropping systems. Some of the species used as intercrops depressed corn or soybean yields significantly. No treatment containing an intercrop was significantly better than the treatment without an intercrop. When no nitrogen was supplied to continuous corn, legume intercrops fixed enough nitrogen to increase yields. Yields were more than doubled by adding 200 pounds of nitrogen per acre and this completely masked any nitrogen fixation or other beneficial effects the intercrop might have contributed.

Soybean yields were maintained regardless of nitrogen fertilization or intercropping practices. The results for corn and soybeans were similar on both Wooster sil and Hoytville silt soils. Nitrogen was necessary to maintain satisfactory corn yields on both soils and there was no apparent tendency for yields to decline under intensive management systems on either soil.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Alexander, M. W., and Genter, C. F. PRODUCTION OF CORN AND SOYBEANS IN ALTERNATE PAIRS OF ROWS. Agron. J. 54: 233-234. 1962.

An experiment was conducted to study two methods of planting corn: (1) Planting solid; and (2) planting in paired rows of soybeans. An early hybrid, Ohio C54, and a full-season hybrid, U.S. 578, were planted at 2 rates with solid planting and at 5 rates with paired rows of soybeans.

Corn planted in alternate pairs of rows with soybeans yielded approximately 30 percent more (for area actually in corn) than when planted alone. Rates of planting in the alternate corn-soybean plots of over 20,000 plants per acre gave no yield advantage with either corn hybrid. Ohio C54 yielded somewhat more than U.S. 578 in most years.

No difference in standability was found between solid plantings and plantings by the alternate corn-soybean method with either hybrid. Rates of planting within hybrids gave no significant difference in percent erect stalks. The increased percentage of lodging and breaking at higher rates of planting in corn tend to be more apparent than real.

On the basis of area actually in soybeans, yields obtained by the intercrop method were about the same as would be expected when planted alone in 36-inch rows.

Va. Agr. Expt. Sta., Holland, Va.

Scott, W. O., and Patterson, F. L. GRAIN SORGHUM AS A COMPANION CROP FOR ALFALFA. Agron. J. 54: 253-256. 1962.

The results of 7 field experiments conducted during the period 1955-57 indicate that 3-dwarf grain sorghum may be used as a companion crop for the establishment of alfalfa. Good cultural and seeding practices are generally required to establish alfalfa in corn or sorghum and vice versa. Grain sorghum was no more competitive than corn as a companion crop when planted in 60-inch rows.

Limited information indicated that alfalfa planted at the same time or later than the sorghum would give little reduction in the yield of sorghum in seasons of normal rainfall in Indiana and Illinois.

Satisfactory grain yields were obtained with 40- and 60-inch rows of sorghum. However, the effect of lower row widths on increasing the yield of sorghum appeared to be greater than with corn.

Competition for light was an important factor in the establishment of alfalfa as an intercrop in sorghum.

U. Ill., Urbana, Ill.

Britt, C. S. SOIL MANAGEMENT OF PEACH ORCHARDS IN EASTERN UNITED STATES. U.S. Dept. Agr., Agr. Res. Serv. Agr. Inform. B. 248, 16 pp. 1962.

As a guide to the development of better soil management practices, the effects of different cultivation methods, use of cover crops, sod, and mulches, and erosion control on tree growth and yields of peaches in the East are reviewed.

General recommendations for good soil management in peach orchards are: (1) Cultivate the area surrounding young peach trees; (2) in bearing orchards use winter cover crops--rye, rye-vetch, oats, ryegrass, and wheat are most commonly used; (3) seed cover crop early in fall and fertilize to obtain vigorous growth; (4) do not allow cover crops to compete with trees in spring and summer; (5) disk cover crop and leave as much residue as possible for a mulch and for organic matter; (6) where erosion is a serious hazard and moisture is sufficient, maintain a permanent sod strip between rows; cultivate around the trees and mow the sod strips occasionally during summer; (7) restrict continuous cultivation; cultivate only across slope if necessary to conserve moisture; and (8) on steep slopes add straw mulch to prevent erosion; add nitrogen fertilizer as needed.

ARS, USDA, Inform. Div., Washington 25, D.C.

Young, R. A. NITROGEN FERTILIZER REDUCES THE NEED FOR SUMMER FALLOW. . . Fert. Solutions. 4(4): 12-15. 1962.

Research in recent years indicates that nitrogen fertilizer when coupled with good weed control methods eliminates the need for summer fallow in the Red River Valley and casts serious doubts on the merits of the practice in the eastern half of North Dakota. Even in the drier part of the State, there are years and situations where nitrogen used on non-fallowed land mitigates the benefit from fallow. In 1958, a study was initiated to measure some of the short-term benefits of fallow, to determine the conditions under which it is or is not profitable, and to determine the effectiveness of fertilizer in reducing the need for fallow. It was concluded that:

1. Summer fallow exposes land to the hazards of wind and water erosion and increases cost of production.



2. It stores some moisture for use by the next crop, permits the accumulation of available nitrogen, and assists in weed control. As a result, yield of the following crop is usually increased.
3. The use of modern weed control methods and nitrogen fertilizer leaves storage of moisture as the only real need for the use of summer fallow. In the higher-rainfall areas where fallow is regularly used now, its acreage should be reduced substantially by using nitrogen fertilizer and selective herbicides to substitute for the nutrient availability and weed control benefits normally derived from fallow. Current income can be maintained or increased while accomplishing improved long-term soil maintenance.
4. The effectiveness of nitrogen fertilizer in reducing the need for fallow is demonstrated by the fact that from 40 to 60 pounds of nitrogen per acre on non-fallow land in the Red River Valley of North Dakota brought average yields of wheat and barley slightly above those obtained on fallow, while without fertilizer, fallow had an advantage of almost 9 bushels. In the East Central area, where moisture is not quite favorable, an average of 30 to 40 pounds of nitrogen reduced the yield benefits of fallow from 10.7 down to 6 bushels per acre.

N. Dak. Agr. Expt. Sta., Fargo, N. Dak.

Klingman, D. L., and Shaw, W. C. USING PHENOXY HERBICIDES EFFECTIVELY--  
2,4-D, 2,4,5-T, MCPA, Silvex, 4-(2,4-DB). U.S. Dept. Agr. F. B. 2183, 24 pp.  
1962.

Phenoxy herbicides--chiefly 2,4-D, 2,4,5-T, silvex, MCPA, and 4-(2,4-DB)--are used widely for controlling weeds in many crops, on grazing lands, and lawns, and for killing unwanted brush and trees. These herbicides are especially useful because: (1) They are selective--they kill most broadleaf plants but do not kill grasses or grain crops; (2) they are potent--many species of weeds are controlled by less than 1 pound of active ingredient per acre; (3) they are easy to use; (4) they are not poisonous to man, domestic animals, fish, or game when applied at the recommended rates; (5) they do not accumulate in the soil and they have no unfavorable effects on soil organisms; and (6) they are not corrosive to spraying equipment.

When sprayed with phenoxy herbicides, leaves, green stems, twigs, flowers, and fruits usually absorb the herbicides. Roots absorb herbicides sprayed on the soil. When applied to growing plants or to the soil, these herbicides rapidly become distributed in the leaves, stems, and roots, causing susceptible plants to die.

These herbicides are absorbed most readily by plants that are growing rapidly. Annual weeds are easiest to kill when they are young. Perennial weeds are easy to kill while they are seedlings; after they are established, most perennials are easiest to kill at the time flower buds appear. Some broadleaf weeds are killed by very small amounts of phenoxy herbicides; others are almost unaffected by very large applications.

The charts list the susceptibility of many common weeds and woody plants to control by 2,4-D, 2,4,5-T, MCPA, silvex, and 4-(2,4-DB).

Tables and photographs.

ARS, USDA, Inform. Div., Washington 25, D.C.

Madison, J. H. THE EFFECT OF MANAGEMENT PRACTICES ON INVASION OF LAWN TURF BY BERMUDAGRASS (CYNODON DACTYLON L.). Proc. Amer. Soc. for Hort. Sci. 80: 559-564. 1962.

In the climate of David, California, Bermudagrass successfully invaded all 9 temperate-season grasses tested. The factors most important in influencing rate of invasion were grass variety and height of cut. Alta fescue and Newport bluegrass were slow to be invaded and slow to be replaced by Bermudagrass. Congressional bentgrass was more rapidly invaded but only slowly replaced. Close mowing appeared to slow the invasion by removing the stolons by which the Bermudagrass spreads. Season of fertilization did not affect rate of invasion, but complete invasion was slower with summer fertilization. Irrigation practices affected invasion, but the manner and extent varied with grass variety. A dense grass mat appeared to retard Bermudagrass invasion.

U. Calif., Davis, Calif.

### Crop Residue Management

Lueken, H., Hutcheon, W. L., and Paul, E. A. THE INFLUENCE OF NITROGEN ON THE DECOMPOSITION OF CROP RESIDUES IN THE SOIL. Canad. J. Soil Sci. 42: 276-288. 1962.

Additions of mineral nitrogen accelerated the initial decomposition rate of incorporated wheat straw, alfalfa hay, and glucose when added to two soils differing widely in organic matter content. However, in the more advanced stages of decomposition the reverse was true, and over the total incubation period larger amounts of carbon were maintained in soils supplemented with nitrogen.

In contrast to all other residues used, nitrogen additions to cellulose effected a continuous and substantial increase in residue decomposition. This was the only residue for which the mineralization of soil organic matter did not supply nitrogen adequate for its decomposition within 120 days.

The very slow rate of decomposition of sphagnum peat could be attributed to its high lignin content, rather than to the nitrogen levels.

Sulphacetolysis analysis, which measures the non-humified carbon, indicated the feasibility of separating non-humified crop residues from the more complex soil organic matter. Addition of organic amendments thus resulted in a drop in the soil humification quotient. Nitrogen resulted in the retention of a significantly higher percentage of the added residue, without a drop in the humification quotient for the high organic matter Melfort soil.

Residue applications to soils produced a significant improvement of structural development, especially in the low organic matter soil (Arborfield).

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

Greb, B. W., and Black, A. L. SORGHUM RESIDUE REDUCTION IN A STUBBLE MULCH FALLOW SYSTEM. Agron. J. 54: 116-119. 1962.

Cultivated sorghum acreage ranks second to wheat as a source of vegetative material for wind and water erosion control in the Central and Southern Great Plains of the United States. Its importance is magnified in a wheat-sorghum-fallow rotation where vulnerability to erosion is highest during the fallow year. Results of three sorghum stubble management experiments showed that residue was lost by two mechanisms: (1) Climatic weathering; and (2) tillage burial. Climatic weathering included loss of residues by wind, decomposition, and possibly leaching of carbohydrate materials. Losses by tillage burial were a function of type of implement, frequency of use, timing, and soil moisture conditions. Undisturbed

stubble lost 31 to 34 percent of the residue weight by overwinter weathering. Combinations of various experimental fallow tillage practices preserved 15 to 45 percent of original sorghum residues at wheat seeding time. Of several tillage methods attempted, subsurface tillage, including wide blades and bar implements, preserved residues more effectively than the use of disk-type implements during the 2 years of comparisons.

SWCRD, ARS, USDA, Central Great Plains Field Sta., Akron, Ohio.

Parker, D. T. INFLUENCE OF MULCHING ON THE MANGANESE CONTENT OF CORN PLANT TISSUE. *Agron. J.* 54: 303-305. 1962.

Seedling corn plants grown on cornstalk residue mulched soil contained less Mn than plants grown on bare soil. Although a marked Mn deficiency did not occur, evidence of an influence on plant physiology was indicated by an accumulation of free <sup>a</sup>-amino-N in very young plants. In soils normally low in available Mn mulching could critically affect the Mn nutrition of corn.

SWCRD, ARS, USDA, Ames, Iowa.

Heiberg, S. O., and Leaf, A. L. EFFECT OF FOREST DEBRIS AND MINERAL FERTILIZERS ON THE AMELIORATION OF SANDY SOILS. *International Union of Forest Res. Organ.* 13th Cong., Wein. Sept. 1961. Separate 23-21, 5 pp. 1961.

On a level, coarse sandy, glacial outwash soil that had been exploited by agriculture for a long period, potassium additions in the form of logging slash, humus, and mineral fertilizers in all cases had a strong positive and lasting influence upon the growth and vigor of several coniferous tree species. The response from the forest debris additions, due to their content of potassium, was greater for the more nutrient-demanding species. Logging slash from a productive site had a stronger effect than slash from a depleted site, and the more nutrient demanding a species the greater the effect of its slash.

Response to applications of potassium fertilizers in various forms were immediate, strong, and lasting, but response to other nutrient element additions were slight to nil.

The effect of both forest debris additions and mineral potash salts lasts more than 25 years.

Forestry, Syracuse U., Syracuse, N.Y.

Lawrence, T., and Kilcher, M. R. THE EFFECT OF FOURTEEN ROOT EXTRACTS UPON GERMINATION AND SEEDLING LENGTH OF FIFTEEN PLANT SPECIES. *Canad. J. Plant Sci.* 42: 308-315. 1962.

Root extract solutions of crested wheatgrass, Russian wild ryegrass, intermediate wheatgrass, couch grass, brome grass, Altai wild ryegrass, wild barley, poverty weed, alfalfa, sweet clover, reed canary grass, timothy, sorghum grass, and dandelion on quartz sand were used as germinating and growing media for seeds of 12 of these species as well as for wheat, oats, and barley.

Root extracts from Russian wild ryegrass, crested wheatgrass, intermediate wheatgrass, brome, timothy, reed canary, and wild barley had little or no effect on the germination of the seed of most species. Those from Russian wild ryegrass and brome had little effect on seedling length. Extracts made from the roots of alfalfa, dandelion, sorghum grass, sweet clover, poverty weed, and couch grass showed the greatest inhibitory effects on both the germination and seedling growth.

Canada Dept. Agr., Swift Current, Saskatchewan, Canada.



Mountain, W. B., and Elliot, J. M. EFFECT OF SUMMER FALLOWING ON THE ROOT LESION NEMATODE (PRATYLENCHUS PENETRANS COBB) AND YIELD OF FLUE-CURED TOBACCO IN ONTARIO. *Canad. J. Plant Sci.* 42: 642-645. 1962.

Field experiments showed that disking of rye straw in early June, rather than at the normal time in mid-July, reduced the population of the root lesion nematode in the roots of the subsequent crop of tobacco as effectively as nematicides. Summer fallowing tended to lower the nitrogen content of the soil and supplementary nitrogen was required to obtain normal yields of tobacco.

Canada Dept. Agr., Harrow, Ontario, Canada.

## Tillage

Siddoway, F. H., and McKay, H. C. TILLAGE OF SWEETCLOVER UNDER DRYLAND CONDITIONS. *Idaho Agr. Ext. Serv. B.* 388, 12 pp. 1962.

Several methods of initially tilling a sweetclover green manure crop under a dryland summer fallow system of farming were investigated.

The number of plants that survived the initial summer fallow tillage was consistently highest for the one-way disk treatment. When the soil was dry to tillage depth, sweep tillage resulted in the most complete kill. The moldboard was superior in this respect when the soil was moist within the tillage zone.

The amount of original residue maintained on the surface for two seasonal extremes ranged from about 10 to 65 percent, 5 to 30 percent, and 1 to 6 percent for the sweep, one-way disk, and moldboard treatments, respectively. Weeding operations with the rod-weeder were not seriously destructive to surface residue.

Nitrates in the surface foot varied more by season and year than among initial tillage treatments. There was an indication, based on protein content of wheat, that nitrogen availability was positively correlated with the quantity of residue on the surface.

Differences in wheat yields attributable to the placement of sweetclover residues and methods of tillage were small.

These results apply to spring grain areas of high elevation with 14 or more inches of annual precipitation and to nitrogen-deficient winter wheat areas where sweetclover can be tilled before surface moisture is depleted.

Tables, graphs, and photographs.

SWCRD, ARS, USDA, and U. Idaho, Col. Agr., Idaho Agr. Expt. Sta., Moscow, Idaho.

Schaller, F. W., and Amemiya, M. WHAT TILLAGE FOR CORN? *Iowa Farm Sci.* 16: 155-158. 1962.

The following methods of tillage are described: (1) Conventional tillage; (2) minimum tillage; (3) wheeltrack-planting; (4) plow-planting; (5) cultivator-planting; (6) striptill-planting; (7) listing; and (8) mulch tillage.

The purposes and effects of the different methods of tillage are given. The authors concluded that:

1. All of these methods are being used for corn to some extent. Each offers advantages for certain operators and farming conditions. Providing a good environment for the

seed and seedling, managing for soil and water conservation, controlling weeds and obtaining good yields are important for any corn tillage method. Opportunities for saving time and cutting costs in relation to the yields obtained vary with the different methods.

2. The conventional tillage method produces good corn stands and good yields, and equipment is well developed and available. Conventional tillage produces the smoothest and firmest seedbed, however, it involves a high number of operations, tends to be the most costly method, and results in more runoff and erosion than minimum tillage methods.
3. Minimum tillage methods produces good stands and yields, favors water absorption, and reduces erosion. The number of times over a field are reduced, and tillage costs are lowered. These methods involve changes in equipment and not all of the items are readily available. Also, these methods require more know how and attention in fitting the operations to soil conditions and seasonal variations. Sometimes more than one method may be necessary to fit conditions on a single farm.

TABLE. Suitability of minimum tillage methods compared with conventional method.

Tillage method	Suitability		Cost <sup>a</sup>	Time <sup>a</sup>	Comments
	For corn stands in row area	For erosion control between rows			
Conventional	--	--	--	--	Suited to all areas.
Wheeltrack-planting	equal or less	more	less	less <sup>b</sup>	Suited to all soils, but requires extra attention to tilling at right soil moisture content to avoid excessive clodding.
Plow-planting	equal or less	more	less	less <sup>b</sup>	Same as above.
Cultivator-planting	equal or less	more	less	less	Same as above; allows fall or early spring plowing.
Striptill-planting	equal or less	more	less	less	Same as above.
Listing	less	more	less	less	Best suited to deep loess soils and bottomlands of western Iowa.
Mulch tillage	less	more	equal or less	equal or less	Suited to most soils except those slow to drain.

<sup>a</sup>From initial seedbed preparation to layby.

<sup>b</sup>Although total field time is less, there is a tendency to "bunch" the work at planting time.

Iowa State U. Sci. and Tech., Ames, Iowa.

Three tillage treatments were compared for winter wheat production following green peas during the 6-year period, 1954-59. They were: (1) Plowing when dry, followed by tillage to produce a conventional seedbed; (2) plowing when dry with no additional tillage; and (3) tilling with a wide blade sweep when dry followed by tillage to produce a conventional seedbed. A fourth treatment using a duck-foot cultivator as the initial tillage with no additional tillage was compared with the other three methods during the last 3 years of the study. All initial tillage was done in July immediately after the harvest of green peas. All plots were uniformly fertilized and seeded.

Yields for all treatments were comparable, except for significantly higher yields on conventional seedbeds in 2 of 6 years of experiment.

Conventional seedbeds required from 2 to 4 more tillage operations than seeding clods. Annual cost of extra tillage operations on conventional seedbeds varied from \$2.00 to \$4.50 and averaged \$2.88 per acre.

Seeding in clods controlled erosion.

SWCRD, ARS, USDA, Pendleton, Oreg.

Cairns, R. R. SOME EFFECTS OF DEEP WORKING ON SOLONETZ SOIL. Canad. J. Soil Sci. 42: 273-275. 1962.

A 6-year study was conducted to determine the effect of working to a depth of 24 inches on the productivity, and chemical and physical condition of a Solonetz soil. Productivity was generally increased during the second rotation by deep working. The extractable calcium content of the A and B horizons was increased and the sodium content decreased. The magnesium distribution was not changed. An intractable B-like horizon reformed in the deep-worked plots. No relation was found between productivity and the balance of extractable cations.

Canada Dept. Agr., Vegreville, Alberta, Canada.

Chepil, W. S., Moldenhauer, W. C., Hobbs, J. A., and Taylor, H. M. DEEP PLOWING OF SANDY SOIL. U.S. Dept. Agr., Agr. Res. Serv. Prod. Res. Rpt. 64, 14 pp. 1962.

Deep plowing of some types of sandy soil increased the organic matter, nitrogen, potassium (as  $K_2O$ ), and calcium (as  $CaO$ ) in the surface soil and therefore increased crop yields. All or some of these soil constituents apparently become depleted rather rapidly, because substantial yield increases lasted only a limited number of years.

Deep plowing increased the clay in the surface soil on an average from about 5 to 12 percent in 2 plots in Texas and 29 fields in Kansas. About 27 percent of clay in the surface soil is required for maximum benefit to control wind erosion.

In Texas, within 5 years after plowing severe erosion on 4-acre plots decreased the clay and consequently increased the sand content in the surface soil almost to before-plowing proportions. It also decreased the fertility elements to nearly before-plowing



proportions. The 4 inches of surface soil had a high to very high susceptibility to erosion 5 years after deep plowing.

In Kansas, deep plowing brought soil clods to the surface, which greatly reduced the susceptibility of the soil to wind erosion. The initially high cloddiness in the surface soil deteriorated within a year or two and reached a level dependent on the proportion of clay brought to the surface. The more clay brought up, the more clods the surface soil contained. The clay remained in the surface soil as long as little or no wind erosion occurred, but it was rapidly depleted when wind erosion was severe.

Deep plowing of some sandy soil produces several beneficial results, but it must be considered only as an aid in wind-erosion control. It must be supplemented with other suitable erosion-control practices. If wind erosion is not controlled, beneficial results will be only temporary.

ARS, USDA, Inform. Div., Washington 25, D.C.

## Fertility Requirements For Conservation Farming

Better Crops With Plant Food. PLANT ANALYSES: A SPECIAL ISSUE. Better Crops With Plant Food. 46(3): 1-56. 1962.

Today the successful farmer cannot depend on guesswork as a guide to fertilizer application. Farming has become a precision business demanding reliable knowledge of plant nutrition needs.

Plant analysis--like soil testing--has become an acceptable research and educational tool in helping the farmer answer questions basic to his economic future: Should I fertilize? What analysis? How much? How often?

The American Potash Institute invited some of the Nation's top authorities on plant analysis to discuss the progress in this field of agricultural research.

Plant analysis is a relatively rapid way of diagnosing the nutritional needs of a crop by using the plant itself as an indicator. Many questions and problems are involved, of course. The three basic ones are: (1) Which part of the plant to sample; (2) which test to use in chemically analyzing these samples; and (3) what nutrient concentration to label "adequate" for specific plant growth. These and other problems are discussed in the following papers:

1. Hardy, G. W. TISSUE ANALYSIS OF COTTON. Ark. Agr. Expt. Sta., U. Ark., Fayetteville, Ark.
2. Tyler, K. B., and Lorenz, O. A. DIAGNOSING NUTRIENT NEEDS IN THE VEGETABLES. U. Calif., Riverside, Calif.
3. Blaser, R. E. YIELD & UPTAKE OF  $P_2O_5$  and  $K_2O$  IN ALFALFA FERTILIZATION. Va. Polytech. Inst., Blacksburg, Va.
4. Ulrich, A. PLANT ANALYSIS--GUIDE TO SUGAR BEET NEEDS. U. Calif., Berkeley, Calif.
5. Sanford, W. F. PINEAPPLE CROP LOG--CONCEPT & DEVELOPMENT. Pineapple Research Institute of Hawaii.
6. Reuther, W., Jones, W. W., Embleton, T. W., and Labanauskas, C. K. LEAF ANALYSIS: AS A GUIDE TO ORANGE NUTRITION. U. Calif., Riverside, Calif.
7. Hanway, J. J. PLANT ANALYSIS--GUIDE FOR CORN NEEDS. Iowa State U., Ames, Iowa.

Morris, H. D., and Celecia, J. F. EFFECT OF TIME OF FERTILIZER APPLICATION ON YIELD AND NUTRIENT UPTAKE OF COASTAL BERMUDAGRASS ON CECIL SANDY LOAM. Agron. J. 54: 335-338. 1962.

A field investigation was conducted on Cecil sl near Athens, Ga., over a 4-year period to determine the most efficient time of fertilizing Coastal bermudagrass.

Applying N in 4-split applications resulted in higher forage yields, more even distribution of forage production over the season, and greater N recovery in the forage than applying one-half of the N in April and one-half in July. Single applications of N in April were inferior to split applications, and fall application was still less effective.

Only slight response to P and K fertilization was obtained. Small, annual applications of P and K were more effective than large single applications at planting. Spring application of P and K effected higher forage yields than fall application.

U. Ga., Athens, Ga.

Oakès, A. J., and Shov, O. RESPONSE OF FOUR PASTURE GRASSES TO NITROGEN IN THE DRY TROPICS. Agron. J. 54: 176-178. 1962.

Four tropical sodgrasses were grown at 4 nitrogen levels on Fredensborg c for 3 years to compare their yielding ability and the efficiency with which they recovered and utilized nitrogen. Ammonium sulphate nitrogen was applied as a top dressing in split applications, one-third in the spring and the remaining two-thirds in the fall at the onset of the rainy season. All grasses responded to applied nitrogen to the highest rate used in their production of increased yields of dry matter and protein per acre. Recovery and utilization of fertilizer nitrogen and pounds of dry forage produced per pound of nitrogen varied with grass species and level of nitrogen. Ranked in descending order of yield and efficiency of using applied nitrogen in forage production, the grasses were: rhodesgrass, Coastal bermudagrass, stargrass, and pangolagrass. Differences in rainfall had no apparent influence on the grass yields nor did the applied nitrogen influence the protein content of the forage. Nitrogen rates influenced the weed competition in the planted grasses.

Virgin Islands Agr. Res. and Ext. Prog., ARS, USDA, Kingshill, St. Croix, Virgin Islands.

Miltmore, J. E., Mason, J. L., and Rogers, C. B. W. INCREASE IN SEED PRODUCTION FROM NITROGEN FERTILIZATION OF NATIVE BEARDLESS WHEATGRASS. Canad. J. Plant Sci. 42: 359-364. 1962.

Nitrogen fertilization greatly increased pure seed yield of native beardless wheatgrass, Agropyron inerme, where the mean annual precipitation was 11 inches in the South Okanagan area of British Columbia. In one experiment in 1959, ammonium nitrate broadcast at 450 pounds of actual nitrogen per acre increased seed yield from 3.5 pounds per acre for the unfertilized plots to 17.5 pounds, a maximum increase of 400 percent. One-hundred and fifty pounds of actual nitrogen per acre increased seed yield 330 percent and the 50-pound rate increased the yield of seed 140 percent. At two other locations in 1961, unfertilized plots yielded 18.8 pounds of seed per acre; 150 pounds of actual nitrogen per acre increased seed yield to 59.2 pounds and the 50-pound treatment produced 46.5 pounds of seed per acre. Yield increases resulted from increases in spike production because weight of seed per spike was not increased by fertilization. Germination was not affected and percent pure seed was slightly increased by the nitrogen treatments. This increase in seed production is considered favorable for the restoration of preferred species on depleted native range.

Canada Dept. Agr., Summerland, British Columbia, Canada.

Morris, H. D., and Reese, E. L. EFFECT OF VARYING LEVELS OF NITROGEN ON FORAGE YIELDS OF SEVERAL RYE VARIETIES AND RYE MIXTURES. Agron. J. 54: 155-156. 1962.

Results of a 3-year field experiment with 3 rye varieties (Florida Black, Abruzzi, and Tetrapetkus) differing in maturity grown singly and in mixtures at varying levels of N fertilization were summarized as follow:

1. Forage yields of all varieties were increased by N fertilization up to 240 pounds of N per acre. The increase in yields resulting from the last 60-pound increment of N was small and would probably not be justified economically.
2. A differential response to N fertilization was obtained among the rye varieties for 2 years of the experiment. Yields of Tetrapetkus, a late variety, were increased more by high N fertilization than the yields of earlier varieties.
3. Forage yields during November and December were greatly increased by high N fertilization in seasons when soil moisture was adequate.
4. Total forage yield of the best rye mixture was not greater than that of the higher yielding variety included in the mixture (Tetrapetkus); however, seasonal production of the mixtures was more favorably distributed than that of the high-yielding variety grown alone.

U. Ga., Athens, Ga.

Boyd, F. T. FERTILITY RESPONSES OF ST. AUGUSTINE, PANGOLA, AND PENSACOLA BAHIA GRASSES ON SOUTH FLORIDA SANDY SOILS. Soil and Crop Sci. Soc. Fla. Proc. 21: 74-80. 1961.

St. Augustinegrass, pangolagrass, and Pensacola bahiagrass were grown on sandy soils near Ft. Lauderdale, Fla., and treated with 2 grades of fertilizer at various times over a 3-year period. St. Augustinegrass on Davie fs produced the highest total forage yields and the most growth during the winter months. Pangolagrass on Arzell fs gave greatest immediate mid-summer fertilizer response and the highest proportional increase from higher N fertilization. Bahiagrass produced lowest total forage yields. Fertilizer response of all grasses was similarly affected by climatic conditions, being adversely affected by drought and low winter temperatures and by seasons of high rainfall intensity.

Positive fertilizer responses were greatest in midsummer and lowest from the middle of October to early April. Fall fertilization was effective on sandy soils when followed by moderate rains or when applied to grasslands having adequate surface soil moisture.

Everglade Expt. Sta., Plantation Field Lab., Fort Lauderdale, Fla.

Beaton, J. D., Read, D. W. L., and Hinman, W. C. PHOSPHORUS UPTAKE BY ALFALFA AS INFLUENCED BY PHOSPHATE SOURCE AND MOISTURE. Canad. J. Soil Sci. 42: 254-265. 1962.

The effect of phosphate source and soil moisture during the initial soil-fertilizer reaction period on subsequent phosphorus uptake by alfalfa was investigated in a growth chamber. Phosphate-treated soils with moisture adjusted to four different tensions were stored at approximately 18° C. for 10 weeks. Following this storage interval phosphorus uptake by alfalfa was measured using a short-term technique.



Phosphorus content and phosphorus uptake by both tops and roots increased significantly when water-soluble materials such as ammonium polyphosphate, monoammonium, and monocalcium phosphate were applied. Less soluble sources, such as hydroxyapatite and anhydrous dicalcium phosphate, were much less effective. Calcium metaphosphate produced intermediate results.

Moisture content of the soil during the reaction period did not greatly alter subsequent P uptake. The water-soluble sources of phosphorus were affected to the greatest degree.

Uptake of P was significantly correlated with the amount of P extracted by  $\text{NaHCO}_3$  from the treated soils. The highest degree of correlation occurred with ammonium polyphosphate-treated soil. A significant negative correlation occurred with calcium metaphosphate. With the exception of the 0.8-bar treatment, moisture tension had little influence on the correlation of P uptake with  $\text{NaHCO}_3$  extractable-P.

Expt. Farm., Res. Br., Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

McKell, C. M., Wilson, A. W., and Williams, W. A. EFFECT OF TEMPERATURE ON PHOSPHORUS UTILIZATION BY NATIVE AND INTRODUCED LEGUMES. Agron. J. 54: 109-113. 1962.

Four introduced and four native legumes were grown for 60 days in a controlled environment at three temperatures ( $50^\circ$ ,  $60^\circ$ , and  $70^\circ$  F.) and at three phosphorus fertility levels (0, 44, and 175 pounds of P per acre). Top growth, root growth, and percent total P in tops were determined for each species for each treatment combination.

In general, top growth, root growth, and P content increased with increasing temperature and increasing P fertility levels. Two introduced legumes, Trifolium subterraneum and T. incarnatum, produced considerably more top and root growth with P fertilization at  $50^\circ$  than did the other six species. Four legumes, T. tridentatum, T. subterraneum, T. incarnatum, and Medicago hispida, exceeded the four other species in growth responses to P at  $60^\circ$  and  $70^\circ$  F.

CRD, ARS, USDA, and U. Calif., Davis, Calif.

Kresge, C. B., and Younts, S. E. EFFECT OF VARIOUS RATES AND FREQUENCIES OF POTASSIUM APPLICATION ON YIELD AND CHEMICAL COMPOSITION OF ALFALFA AND ALFALFA-ORCHARDGRASS. Agron. J. 54: 313-316. 1962.

Annual potassium applications of 0, 83, 165, and 331 pounds per acre were made to alfalfa and an alfalfa-orchardgrass mixture. Potassium was applied in single and split applications at different times during the growing season. Yields were measured for 3 years and percent potassium in the forage was determined at each harvest.

In most cases, maximum yields of both forages were achieved with 165 pounds of potassium per acre per year.

When potassium was split evenly and applied in the spring and after the first cutting, maximum yield was obtained with 83 pounds per acre.

Most efficient plant use of applied potassium was made possible with the spring plus first cut method of application. A high percent potassium recovery coupled with a near optimum seasonal distribution provided explanation for this efficiency.

The critical potassium level (that percentage in harvested forage below which a significant decrease in yield from the maximum occurs) varied throughout the growing season, with a peak at mid-summer (2.00). Perhaps increased emphasis should be placed on providing the plants' "strengthening needs" at this time.

Large quantities of orchardgrass in the first two cuttings raised the critical potassium level of the mixture over alfalfa alone--1.75 to 1.85 percent.

Split spring and after the first cutting applications of 83 and 165 pounds of potassium per acre more nearly approached the optimum potassium needs of alfalfa and alfalfa-orchardgrass.

U. Md., College Park, Md.

Rixon, A. J., and Sherman, G. D. EFFECTS OF HEAVY LIME APPLICATIONS TO VOLCANIC ASH SOILS IN THE HUMID TROPICS. *Soil Sci.* 94: 19-27. 1962.

A series of replicated field trials, using four levels of lime with three levels of phosphate superimposed across the lime levels, was established in the high rainfall region of the island of Hawaii. The phosphate was applied at levels of 0, 200, and 400 pounds of  $P_2O_5$  per acre. The lime applications in the form of crushed coral stone were heavy, corresponding to the high buffering capacity of these hydrated amorphous soils. It was intended that the heaviest coral dressing should produce a soil pH of 7.0. Three soil series used were the Akaka and Hilo series, which belong to the hydrol humic latosol group, and the Kaumoali series, which belongs to the humic latosol group. These soils are used for sugar cane production. Coral dressing of up to 22,000 pounds per acre was applied to the soils of the Hilo series and to one of the areas of the Akaka series. The other area of soils of the Akaka series received up to 34,000 pounds of crushed coral per acre, while the Kaumoali series received up to 46,000 pounds of crushed coral per acre as its heaviest dressing. The coral stone used contained more than 95 percent calcium carbonate.

Approximately 5 months after the installation of these experimental areas, soil samples were taken and analyzed. The following results were obtained from soils receiving the highest rates of application of lime; (1) There was a general increase in pH, but in no instance did the heaviest dressings of crushed coral stone achieve neutrality. (2) An increase in exchangeable calcium was accompanied by a decrease in extractable aluminum. This relationship was highly significant for each soil. (3) Highly significant negative correlations between extractable aluminum and pH, and positive correlations between the logarithmic values of exchangeable calcium and pH were found. And (4) no significant alteration of the cation-exchange capacity due directly to liming was obtained for any of the soils.

Any significant modification due to phosphate application was confined to a particular level of applied crushed coral. There was a significant increase in cation-exchange capacity with each addition of phosphate to the soils of the Hilo series that had received 22,000 pounds coral per acre. For the soils of the Akaka series, each increase in added phosphate produced a decrease in exchangeable calcium for the plots which had received 34,000 pounds coral per acre. The decrease in exchangeable calcium produced with the application of 400 pounds phosphate per acre in these plots was significant. A significant increase in exchangeable calcium was obtained with the 400-pound phosphate additions to the soils of the Kaumoali series that had received 30,000 pounds coral per acre.

U. Hawaii Agr. Expt. Sta., Honolulu, Hawaii.

Lundy, H. W., and Fiskell, J. G. A. RESPONSES OF CLOVER VARIETIES TO MINOR ELEMENT FERTILIZATION AT THE SUWANNEE VALLEY STATION. *Soil and Crop Sci. Soc. Fla. Proc.* 21: 171-178. 1961.

Crimson clover and Kenland red clover grow well on soils, such as Blanton fs and Scranton fs, provided proper liming and fertilization are used. High calcic limestone and



dolomitic limestone may be required. The 0-14-14 or 0-10-20 fertilizer should contain minor elements, preferably slowly soluble boron frits so that boron availability is maintained during the year. Alternatively, commercially available calcitic limestone containing frit 501 is as acceptable as having the minor elements in the fertilizer. In these tests, the two above varieties reseeded well. Hubam did excellently the year it was planted but did not establish well the second year. This variety sown annually was the highest yielding and had the least need for addition of minor elements.

Live-over of Nolin's, White Dutch, and Ladino clovers was observed all 3 years, which was surprising because several summer droughts occurred. These varieties also were sensitive to proper liming and responded well to the slowly soluble minor element mixtures applied either in the lime or in the fertilizer.

These studies showed that several clover varieties could be grown in the Suwannee Valley soils that are not too droughty. A recent Soil Survey of Suwannee County showed that there are 31,000 acres of soil types that are similar in moisture-holding properties to those on which these experiments were conducted. The addition of minor elements in clover fertilization resulted in large yield increases and provided a better chance for a successful crop.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Cressman, H. K., and Davis, J. F. SOURCES OF SULFUR FOR CROP PLANTS IN MICHIGAN AND EFFECT OF SULFUR FERTILIZATION ON PLANT GROWTH AND COMPOSITION. *Agron. J.* 54: 341-344. 1962.

Field studies were conducted from 1957 through 1960 on 1 organic and 4 mineral soils (Houghton muck, Kalamazoo sl, Hodunk l, Sims cl, and Karlin ls) to determine the need for additional sulfur and its role in the soil fertility problems of Michigan.

Three of the highly concentrated and practically sulfur-free phosphorus carriers (0-20-0, 21-23-0, 0-27-0) were compared with ordinary superphosphate (0-9-0) as the source of phosphorus in a basic fertilizer (formulas show elemental composition of N-P-K). Additional treatments were made by adding gypsum as a sulfur source to these concentrated carriers to determine the effect of sulfur on crop residue. The non-fertilizer sources of sulfur in the soil, precipitation, and atmosphere were determined at all experimental locations. All crops were analyzed for total sulfur and protein.

Sulfur amendments did not increase the yields or the protein content of any of the experimental crops. Potatoes and red clover showed increased sulfur contents from additions of sulfur in the fertilizer when grown on an infertile sandy soil in northern Michigan. The increased sulfur in sulfur-fertilized potatoes existed mainly in the sulfate form. The amount of sulfur in the precipitation averaged 10.1 pounds per acre annually. The amount of SO<sub>2</sub> in the atmosphere was more pronounced in industrial areas of the state.

The supplies of sulfate or "available" sulfur in the five different Michigan soils studied plus that supplied in the precipitation appeared to be adequate for the maintenance of normal crops in present crop rotation systems. This condition might be altered if there were a pronounced shift to the production of crops with much higher sulfur requirements.

J. Article 2877, Mich. Agr. Expt. Sta., East Lansing, Mich.

Holden, E. R., and Boytoyan, W. R. REACTIVITY OF BORON GLASSES IN AQUEOUS SOLUTIONS. *J. Assoc. Off. Agr. Chem.* 45: 455-463. 1962.

The need for slowly-soluble carriers to provide a steady supply of boron for crops grown on coarse-textured soil has long been recognized. Suitability of a glass depends on



rate of boron release, which, unless controlled, varies widely with changes in composition and fineness. For satisfactory results, release rate in the soil must be held within a relatively narrow "moderate" range. Dissolution in the useful range proceeds continuously throughout growth of the crop and approaches completion only at the end of the season. To insure this condition, a standardized control procedure is needed for determining the relative reactivity of glass carriers.

Rate of nutrient release from a glass varies directly with temperature and indirectly with pH. Degradation of a glass is also controlled in varying degrees by a siliceous coating which forms on the reactive surface. The extent of this influence depends on the nature and concentration of the salts in the aqueous phase, largely as they relate to the flocculation of colloidal matter.

Particle coating appears to have some effect on the release of boron when glasses are agitated with pure water at room temperature. However, when ionic strength is increased more rapidly by digestion at elevated temperatures, or by use of buffer solutions, release slows markedly and in some cases almost ceases entirely. Low concentrations of divalent metallic ions, such as calcium or barium, may lower total release to less than one-tenth as much as that with pure water.

The siliceous coating increases in thickness and consolidates into an opaline material when a glass stands undisturbed in pure water or in moist soil over long periods of time.

The milliequivalents of alkali released per gram of glass during extraction with water were proportional to percent of total boron released. Thus, simple titration of total alkali would serve equally well as a measure of reactivity.

Boron release in rapid digestion procedures and room temperature procedures shows good correlation with boron uptake by alfalfa. The range of reactivity best suited to crop growth in terms of percentage amounts of boron dissolved from non-classified particles of grinds was about: 1-4% by 48-hour agitation with water at 25° C.; 3-9% by 4-hour digestion with water at 100° C; 12-22% by 4-hour digestion with 0.05M sodium bicarbonate, pH 9.4, at 100° C; and 28-60% by 16-hour agitation with 0.44M ammonium acetate, pH 4.0, at 25° C.

The two most satisfactory chemical procedures for determining the relative reactivity of glass carriers were 16-hour agitation with ammonium acetate at pH 4.0 and 4-hour digestion with sodium bicarbonate. Results with ammonium acetate show better reproducibility. However, the sodium bicarbonate procedure is faster and the relationship of the values to crop boron, or to specific surface of individual glasses, are less skewed in the upper part of the useful range of reactivity.

SWCRD, ARS, USDA, Beltsville, Md.

## Salinity and Alkali Problems

Dewey, D. R. GERMINATION OF CRESTED WHEATGRASS IN SALINIZED SOIL. *Agron. J.* 54: 353-355. 1962.

Four strains of standard crested wheatgrass were germinated under laboratory conditions in soil brought to field capacity with water containing 0, 6,000, 12,000, and 18,000 p.p.m. of added salt. Percent germination was decreased, and germination time was increased on a strongly linear scale as salinity was increased from 0 to 18,000 p.p.m. Strains differed in their ability to germinate in salinized soil, and these differences became more pronounced as the salinity level was increased.

Sixteen progenies derived from four crested wheatgrass strains selected at four salinity levels were evaluated in germination trials similar to those applied to the parent strains. Progenies previously selected under conditions of high salinity produced seed that was more tolerant to salinity than was the seed from progenies selected under nonsaline conditions.

Sufficient genetic variability apparently exists within crested wheatgrass with regard to salt tolerance, as measured by germinability, to make selection procedures effective in developing salt-tolerant strains of this species.

CRD, ARS, USDA, Logan, Utah.

Kelley, W. P. SODIUM CARBONATE AND ADSORBED SODIUM IN SEMIARID SOILS. *Soil Sci.* 94: 1-5. 1962.

In a study of sodium carbonate and adsorbed sodium in semiarid soils, the author concluded:

1. Sodium carbonate, as measured by dissolved  $\text{CO}_3$ , may occur in semiarid soils in consequence of the interaction between  $\text{CaCO}_3$  and neutral Na salts. In this case,  $\text{Na}_2\text{CO}_3$  is not highly important for the reason that Ca is also brought into solution.
2. The use of irrigation water that contains  $\text{HCO}_3$  in excess of Ca + Mg may lead to relatively high concentrations of  $\text{NaHCO}_3$  in the soil solution but not generally to agriculturally significant amounts of  $\text{Na}_2\text{CO}_3$ .
3. The precipitation of  $\text{CaCO}_3$  in consequence of applying  $\text{HCO}_3$ -containing water tends to bring about an increase in the Na percentage in the soil solution, but where the drainage conditions are favorable the concentration of the soil solution is held in check by leaching that normally takes place in ordinary irrigation practice.
4. With many soil types adsorbed  $\text{Na}^+$  is far more important than dissolved  $\text{CO}_3$ . The pH of such soil is likely to be high, dissolved Ca low, and their physical properties unfavorable. The effects of adsorbed  $\text{Na}^+$ , however, are far from uniform in all soils. Although adsorbed  $\text{Na}^+$  is usually readily replaceable by  $\text{Ca}^{++}$ , occasionally it is found to be only partially replaceable by gypsum. The effects on the physical properties of the soil are also not constant.
5. Adsorbed  $\text{Na}^+$  affects different kinds of adsorptive materials to different degrees; hence, knowledge as to the specific kind of cation-exchange material in a given soil may be important.
6. The importance of cation exchange resulting from the accumulation of Na salts in semiarid soils is great, but many factors are capable of influencing to a considerable degree both the exchange and the soil properties resulting therefrom.
7. Alkali soils may be considerably more complex than is generally appreciated.

U. Calif., Berkeley, Calif.

Bower, C. A., and Hatcher, J. T. CHARACTERIZATION OF SALT-AFFECTED SOILS WITH RESPECT TO SODIUM. *Soil Sci.* 93: 275-280. 1962.

Methods commonly employed to determine ESP (exchangeable-sodium percentage) are not satisfactory for some salt-affected soils. With highly saline soil, the correction of the exchangeable Na determination for soluble Na content tends to be high when based on analysis of an equilibrium water extract (for example, saturation extract). The high values for soluble Na content are related to negative adsorption effects, and they result in low values for exchangeable Na content. On the other hand, some salt-affected soils contain forms of Na which, although are not readily soluble in water or exchangeable, dissolve upon extraction of exchangeable cations with salt solutions such as  $\text{NH}_4\text{Ac}$  and cause high values for exchangeable Na content. For some soils, the ESP can best be estimated from its average

relation to the SAR (sodium-adsorption ratio) of an equilibrium water extract of the soil. For salt-affected soils in general, the SAR of an equilibrium extract is perhaps the best value for relating Na status to plant growth, and its relation to the ESP provides a means of cross checking the reliability of direct determinations of the latter value.

SWCRD, ARS, USDA, Riverside, Calif.

Nieman, R. H. SOME EFFECTS OF SODIUM CHLORIDE ON GROWTH, PHOTOSYNTHESIS, AND RESPIRATION OF TWELVE CROP PLANTS. *Bot. Gazette* 123: 279-285. 1962.

The effect of NaCl on some aspects of growth and on rates of photosynthesis and respiration was examined with twelve crop species covering a wide range of salt tolerance. Plants were grown in the greenhouse on gravel cultures irrigated with either a base nutrient solution (control) or base nutrient plus 1,2,3, or 4 atm. OP of NaCl. Photosynthesis and respiration were measured with tissue samples in the Warburg apparatus.

The growth response to NaCl, judged by the yield of fresh plant tops, ranged from a stimulation in the case of some tolerant species to a severe depression and death of the most sensitive one.

NaCl increased the succulence of leaves (water content per unit area) of all species except onion. It also increased the ratio of water to dry matter in the leaves of most species; the greatest increase occurred in beet and spinach, the two most tolerant species.

There was no correlation between salt tolerance and photosynthetic activity per unit area of leaf samples. The activity per unit of chlorophyll tended to be higher in the more tolerant species.

Leaf samples did not indicate any appreciable suppression of photosynthetic activity per unit area by NaCl. The suppression observed in pea was probably caused by the combination of salt and supraoptimal growth temperatures. For the most part, the results are consistent with the conclusion that photosynthate is generally not a limiting factor in the growth of salt-stunted plants.

Respiration of leaves was more sensitive to NaCl and tended to increase in both tolerant and sensitive species on saline cultures. The effect was generally greater and occurred at lower levels of salt in the more sensitive species. Respiration of root samples failed to indicate any consistent effect of NaCl.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif.

Qayyum, M. A., and Kemper, W. D. SALT-CONCENTRATION GRADIENTS IN SOILS AND THEIR EFFECTS ON MOISTURE MOVEMENT AND EVAPORATION. *Soil Sci.* 93: 333-342. 1962.

A study to determine the effects of salt concentration gradients on the movement of moisture within a soil profile and evaporation from soil surfaces, two salts (NaCl and CaCl<sub>2</sub>) were used, and five different moisture contents were maintained. In one case layers of salt were spread on the surface of soil columns and the soil sealed in lucite cylinders. After definite time periods the columns were cut up and analyzed for salt and moisture.

The data indicate a definite movement of moisture to the salt-bearing surface as diffusive flow at moisture contents less than 1/2 field capacity. Viscous flow, however, dominated at higher moisture contents.

To determine the effects of salt gradients on evaporation, soil columns 20 cm. in length were placed under flood lamps. Water tables were maintained at a fixed level near



the bottom of these columns. NaCl was mixed in the soil in the upper 10 cm. of each column in the amounts 0.0, 0.1, 0.2, 0.4, 1.0, and 2.0 percent of the weight of the dry soil. The columns were wetted and the rates of evaporation measured. When it could be assumed that steady-state conditions existed, the columns were sectioned and analyzed for NaCl and water.

There was greater evaporation from soils with low salt levels in comparison with those with no salt. At high salt levels the salt formed a white crust at the top and the rate of evaporation was lower, even in comparison with soils with no salt. High salt contents were found to lower the water-holding capacity of the soil.

The data indicate that if the salts in slightly saline soils are removed by reclamation, it is possible to effect a saving of as much as 25 percent in evaporation losses and as much as 12 percent in the water needed to grow crops.

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## Cover Crops and Green Manure Crops

Smith, A. D., Horricks, J. A., and Andrews, J. E. EFFECT OF COVER CROPS ON WINTER SURVIVAL, COMMON ROOT ROT, AND YIELD OF WINTER WHEAT. *Canad. J. Plant Sci.* 42: 286-293. 1962.

In Western Canada, cereal cover crops are sown on fallow in late July to protect soil from erosion from August to April and to provide forage in the fall.

When four varieties of winter wheat (Yogo, Kharkov 22 M. C., Jones Fife, and Elgin) were sown into wheat, oat, or barley cover crops, the yields were lower than when they were sown on fallow. The yield of winter wheat sown into the different cover crops was highest in barley and lowest in wheat cover crop. When the growth of cover crops was abundant, the yield of winter wheat was reduced. Application of ammonium-phosphate-sulphate fertilizer (16-20-0) increased the yield of winter wheat and generally decreased the severity of common root rot. Winter survival was generally greater when winter wheat was sown into cover crops than when it was sown on fallow. Root rot was most severe in winter wheat sown into wheat cover and was progressively less severe when sown into fallow, barley, or oat cover. Neither blade-cultivating nor mowing the cover crop prior to seeding the winter wheat appreciably affected the yield.

Canada Agr. Res. Sta., Lethbridge, Alberta, Canada.

## Climatic Influence

Hershfield, D. M. EXTREME RAINFALL RELATIONSHIPS. *J. Hydraul. Div., ASCE* 88 (HY 6): 73-92. Nov. 1962.

A number of rainfall relations pertaining to hydrologic design was presented. The rainfall material was presented in map, tabular, and graphical form and was based largely on the experience of analyzing United States extreme rainfalls both on an individual storm basis and a frequency basis.

The extreme rainfall relations were summarized as follows:

1. The average time-distribution relation, which is valid for 6 hr., 12 hr., 18 hr., and 24 hr. storms, showed that approximately 50 percent of the rain fell near the center of the storm period in approximately 20 percent of the storm duration.

2. The average depth-area relations varied slightly but systematically with geography, indicating the effect of the different storm-types on the shape of the depth-area curves.
3. The ratio of 2-yr., 1-hr. to 2-yr., 24-hr. rainfalls showed pronounced geographical distributions and varied from 10 percent to 60 percent with an average of 40 percent for the entire United States. The ratio of 2-yr., 6-hr., to 2-yr., 24-hr. rainfalls varied from 50 percent to greater than 80 percent with an average of 70 percent for the entire United States.
4. The 24-hr. coefficient of variation from series of annual maxima varied from less than 25 percent to greater than 45 percent with an average of 37 percent for the United States.
5. The ratio of the 24-hr. probable maximum precipitation estimated by the traditional methods to the 100-yr., 24-hr. rainfall varied from a factor of less than 2 to 10 with an average of 5.
6. Several hypothetical examples indicated that the magnitude of a rainfall equal to the mean plus 15 standard deviations was equivalent to a rainfall approximately 3 times the maximum observed from a long period of record.
7. The mean of a series of annual maximum rainfalls multiplied by seven enveloped the maximum rainfall at the corresponding station.
8. The maximum observed rainfall multiplied by a factor of 3.3 will provide an estimate of the maximum rainfall that is likely to occur at a station that might be too large but certainly not too small.
9. Approximately one-third of the years of record did not contribute to the partial duration series. There was an even chance that the largest of two storms that occurred within 2 months of each other occurred first. There was a 1 percent chance that two storms equal to or greater than a 1-yr. storm occurred within 24 hours of each other.

SWCRD, ARS, USDA, Beltsville, Md.

Hershfield, D. M. AN EMPIRICAL COMPARISON OF THE PREDICTIVE VALUE OF THREE EXTREME-VALUE PROCEDURES. J. Geophysical Res. 67: 1535-1542. 1962.

Several thousand station-years of rainfall data from many stations were fitted to the three commonly used extreme-value procedures: lognormal distribution fitted by the method of moments and the Fisher-Tippett type I distribution fitted by both the Gumbel and Lieblein methods. Tests using both the developmental and independent data produced various results. The Gumbel procedure was found to be the best of the three for estimating the probabilities of extreme rainfalls beyond the range of data for the independent data tests. The lognormal and Lieblein procedures gave nearly identical return-period estimates and provided a closer fit to the developmental data than the Gumbel procedure. The average difference in magnitude between the 100-year values from the lognormal and Lieblein procedures on the one hand and the Gumbel procedure on the other was approximately 10 percent, and the Gumbel was always larger.

SWCRD, ARS, USDA, Beltsville, Md.

Neff, E. L., and Bloomsburg, G. L. PRECIPITATION CHARACTERISTICS IN THE PALOUSE AREA OF IDAHO AND WASHINGTON. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-66, 16 pp. 1962.

Precipitation records collected in the Palouse area of Idaho and Washington were analyzed to determine: (1) The depth-time distribution; (2) the depth-area distribution; and

(3) the depth-duration-frequency relations. Storms were arbitrarily separated into two types--those occurring from October through April were classified as "winter type" and those occurring May through September, as "summer type." Storms were further subdivided by the duration and the form of the precipitation. A storm was defined as a period of continuous precipitation immediately preceded and followed by a minimum of 3 hours during which no precipitation was recorded.

In the depth-time distribution the average summer-type storms were more variable than the average winter-type. "Advanced" and "delayed" storms were found in both the summer- and the winter-type.

Form of the precipitation had a greater influence on the depth-area distribution than did the season of the year in which the storm occurred. The average snowstorm had a more limited areal coverage than did the average rainstorm. Also longer duration storms tended to be more uniform over the storm area. Apparently the amount of storm precipitation did not have a significant influence on the depth-area distribution.

Records from a rain gage that had been in continuous operation for 27 years were used in the depth-duration-frequency study. Slopes of the frequency curves of shorter duration storms were the steeper, which indicated greater variability in this group. As the duration increased, the slopes flattened until they reached a constant at 11 hours for summer-type storms and at 8 hours for winter-type. For any given duration, the slope the frequency curve of the summer-type storm was steeper than that for the winter-type.

ARS, USDA, Inform. Div., Washington 25, D.C.

Shaw, L. H., and Durost, D. D. MEASURING THE EFFECTS OF WEATHER ON AGRICULTURAL OUTPUT: PROCEDURES FOR CONSTRUCTING WEATHER INDEXES. U.S. Dept. Agr., Econ. Res. Serv. ERS-72, 49 pp. 1962.

How much of the dynamic increase in agricultural output in recent years is due to weather and how much to technology? Researchers and policymakers in agriculture have long struggled to analyze these forces separately, but year-to-year variation in yields due to weather obscures the changes due to improvements in technology. A procedure for separating the effects of these two factors in a changing agricultural output is presented.

Weather indexes for corn yields and production in Iowa from 1929 to 1960 were constructed using a plot data approach. State indexes were developed by aggregating weather indexes for individual Crop Reporting districts. The weather indexes were used in adjusting for the influence of weather the State and district actual yields per harvested acre and total production of corn. Variation in the adjusted yield series is an estimate of the effect of changes in technology.

The series of adjusted corn yields for Iowa, 1929-60, indicates that improved technology increased yields in two steps. Yields from 1929 to 1935 were relatively stable. Beginning around 1935, corn yields increased rapidly until the early 1940's. This was the period marked by the rapid acceptance of hybrid seed corn. Corn yields remained at the new level throughout the 1940's and early 1950's. Then about 1954 a second period of yield increase began. This second increase does not appear to be due to any single factor but to a combination of improved practices such as increased use of fertilizer and higher planting rates.

Although the purpose of constructing weather indexes in this study was to separate the effects of weather and technology in aggregate agricultural output measures, the indexes per se are valuable research tools. They provide a measure of the "what" of weather which can be used in investigating the "why," the cause-and-effect relationships between individual meteorological factors and crop production. The indexes may also be used to study climate. They provide a measure of variability in agricultural output due to the influence of weather.



Another use of weather indexes is in measuring the yield effect of a changing weather-technology interaction. With technological advances of the last generation, man is now able to control a greater portion of his crop-growing environment than he could in 1930. In Iowa it appears that improved technology has reduced the effects of bad weather on corn yields but has not yet capitalized on good weather.

ERS, USDA, Inform. Div., Washington 25, D.C.

Wischmeier, W. H. STORMS AND SOIL CONSERVATION. J. Soil and Water Conserv. 17: 55-58. 1962.

Recent research results show that the extensive rainfall data recorded in the United States over the past half century can be used effectively to help determine the most efficient use of agricultural land. Soil loss data are more valuable when supplemented with rainfall information. Together the data serve as one of the guides for determining which acres may be safely used for production of pastures or other uses. For acres continued in crop production, rainfall data is advantageous in determining what conservation practices are needed on each field to maintain and improve soil productivity.

SWCRD, ARS, USDA, Lafayette, Ind.

Kolega, J. J., and Palmer, R. S. TEMPERATURE GUIDE FOR NEW ENGLAND. N. H. Agr. Expt. Sta. Tech B. 105, 73 pp. 1961.

This publication has been prepared for those concerned with agricultural planning and development. It presents air temperature data for New Hampshire and the surrounding New England region based on a study of weather records. Emphasis is given to information for applications relating to agricultural engineering problems.

SWCRD, ARS, USDA, and Agr. Expt. Sta., U. N. H., Durham, N. H.

Hendershott, C. H. THE RESPONSES OF ORANGE TREES AND FRUITS TO FREEZING TEMPERATURES. Proc. Amer. Soc. for Hort. Sci. 80: 247-254. 1962.

Injury of citrus fruits and trees by unusually cold weather has resulted in considerable economic loss to growers in the past and is one of the important problems the industry must take into account. The cooling rate, temperatures reached, and subcooling of oranges artificially frozen on trees, together with after effects of the cold on tree response were studied. The author concluded:

1. The cooling rate of fruits was not influenced greatly by fruit size in the two varieties of oranges.
2. The freezing point of Pineapple and Valencia orange fruits ranged from 27.5° to 29° F. with the majority of fruits freezing at 28° to 29°.
3. Subcooling as much as 5° F. occurred in orange fruits. In considering the 29 trees frozen and recording the temperature of 19 fruits from each tree, it was noted that generally fruits subcooled to near 24° F. before freezing. Fruit freezing did occur at a higher temperature (26°) when held for a long period of time (11.25 hours).
4. Critical temperature for leaf killing was 20° F.

5. Wood damage at freezing temperatures was associated with the length of new growth present. Leaf retention was indicative of wood 1 inch or greater in diameter killed.

Fla. Citrus Comn. and Citrus Expt. Sta., Lake Alfred, Fla.

West, S. H., and Prine, G. M. INFLUENCE OF ROW DIRECTION ON MICROCLIMATE, YIELD, AND DAMAGE BY FREEZING IN LUPINE AND OATS. Soil and Crop Sci. Soc. Fla. Proc. 21: 140-147. 1961.

Lupine and oats are grown in Florida in the season when the sun is declined southwardly and the angle of incidence of the sun's rays to the earth's surface is less than 50°. Consequently, solid rows of these upright crops oriented in a east-west direction cast shadows on the north side of the row. If the plants are as tall as or taller than the width of the row, direct rays from the sun may not reach the soil surface during most of the day. Because of the continuous shade, soil and air temperatures are expected to be lower and humidity higher in rows oriented east-west. Therefore, reduced plant growth and higher incidence of disease may result. Rows oriented north-south will receive a more even distribution of sunlight on both sides and on the soil between the rows.

Effect of row direction on microclimate and yields of lupine and oats were studied. The authors concluded that:

1. Shadows cast by lupine plants in rows oriented east-west lowered soil temperatures at 1-inch depth as much as 10° F. at midday on sunny, still days. Even at the 4-inch depth soil temperatures in the east-west rows were 2° F. lower than temperatures at the same depth in north-south rows.
2. Air temperatures in lupine rows oriented east-west were lower than temperatures at the same location in north-south rows. The effect of row direction on air temperatures was not as great as that on soil temperatures.
3. Humidity was higher in east-west rows than in north-south rows.
4. The yield of lupine was significantly greater in the east-west rows than in the north-south rows both years.
5. The influence of row direction on soil and air temperatures was not as great in oats as in lupine. Yield of Florad oats and soil nitrification were not affected by row direction.
6. Severe freeze damage occurred in oats clipped to 2-inch stubble height 2 days before freezing temperatures prevailed. Non-clipped (14 inches tall) oats were damaged slightly by the freezing temperatures. But, oats which had been clipped to 2-inch stubble height 2 weeks before the low temperatures occurred were not damaged. Similar freeze damage occurred both years of the test.

CRS, ARS, USDA, Gainesville, Fla.

Dubetz, S., Russell, G. C., and Anderson, D. T. EFFECT OF SOIL TEMPERATURE ON SEEDLING EMERGENCE. Canad. J. Plant Sci. 42: 481-487. 1962.

Rate and percentage of emergence of 19 native and cultivated herbaceous species were studied at the following soil temperatures: 6°, 13°, and 24° C. The soil temperatures were held uniformly constant, and emergence data at the end of 5 weeks from four replications in time were obtained. The rate of emergence of all species was greater at 18° than at 6° C., and of all but five species was greater at 24° than at 18° C.

The percentage of emergence of barley, brome grass, crested wheatgrass, mustard, oats, peas, spring wheat, and wild oats was not significantly affected by soil temperature. Beans, corn, sugar beets, and sunflowers showed significantly lower emergence percentages at 60° C. than at the three higher soil temperatures. Alfalfa, creeping red fescue, winter wheat, orchardgrass, rough fescue, sweet clover, and flax emerged best at moderate soil temperatures.

Canada Agr. Res. Sta., Lethbridge, Alberta, Canada.

Robertson, W. K., Schroder, V. N., Lundy, H. W., and Prine, G. M. CARBON DIOXIDE, AS IT AFFECTS CORN YIELDS. Soil and Crops Sci. Soc. Fla. Proc. 21: 229-237. 1961.

The role of CO<sub>2</sub> as a limiting factor in corn production under field conditions is discussed. Three experiments in which several methods were used to try to increase the amount of CO<sub>2</sub> available to corn plants are reported. Corn plants were grown in fiber glass walled enclosures 8 feet square and 8 feet high in which CO<sub>2</sub> was released from tanks at rates up to 1 liter per minute. This amount of CO<sub>2</sub> restored 15 bushels of the 16 bushel per acre drop in yield caused by the enclosures. Chicken manure applied at rates of 45 tons per acre in the enclosures was almost as effective as the direct release of the CO<sub>2</sub>, although neither increase was significant at the 5-percent level. Chemical analyses of the soil from this and another experiment where yield increases for chicken manure were significant at the 5-percent level showed higher phosphorus, potassium, calcium, and magnesium where chicken manure was applied while chemical data from corn ear leaf samples at tasseling time showed no differences in these elements or nitrogen indicating that possibly CO<sub>2</sub> or other factors not measured was causing the yield differences.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Prine, G. M. LIGHT, A FACTOR TO BE CONSIDERED IN GROWING CORN. Soil and Crop Sci. Soc. Fla. Proc. 21: 221-228. 1961.

Four field experiments gave evidence that light is an important limiting factor when corn is grown at high populations. Light conditions were made more favorable at several different plant populations up to 30,000 plants per acre by the methods of: (1) Planting tall and short corn varieties in alternate rows; (2) topping plants on alternate corn rows; (3) interplanting corn with soybeans and peanuts; and (4) placing aluminum foil reflectors on soil. Better light conditions resulted in increased grain yields per acre and per plant mainly because more ears were produced per plant. Ear weight remained the same under wide variation in light conditions, though extreme environmental stress, such as increasing population from 15,000 to 30,000 plants per acre, did reduce ear weight. Apparently, the first effect of inadequate light on prolific corn hybrids is reduction in number of ears per plant. Ear weight may be reduced also, if light is extremely limiting.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

## Surface Soil Removal

Moldenhauer, W. C., Holmberg, G., and Shrader, W. D. ESTABLISHING VEGETATION ON EXPOSED SUBSOIL IN THE MONONA-IDA-HAMBURG SOIL ASSOCIATION AREA OF KANSAS, IOWA, MISSOURI, AND NEBRASKA. U.S. Dept. Agr., Agr. Res. Serv. Agr. Inform. B. 251, 14 pp. 1962.

Erosion of exposed subsoil is a serious problem on basin terraces, cut slopes, borrow areas, earth fills, highway backslopes, and similar areas. On a highly erodible subsoil, as



that found in the Monona-Ida-Hamburg soil association area of Iowa, silt eroded from exposed subsoils in one year can drastically reduce the capacity of a road ditch or a basin terrace for conducting or storing water.

With stepped-up highway construction and with increased watershed work, both in the Little Sioux watershed and under Public Law 566, more and more acres of subsoil are being exposed each year. Since the areas exposed in watershed development and highway construction and the costs of building these structures are great, it is important that the subsoils be stabilized as quickly as possible.

At present, the most practical method of stabilizing subsoil areas is to establish a vegetative cover. Fortunately, the Monona-Ida-Hamburg subsoils are friable and easy to work. A seedbed can be prepared easily. The subsoils are very low in nitrogen and available phosphorus and highly erodible. Erosion is often excessive during the period when seedlings are too small to give adequate protection. The cost of establishing vegetation on these sites is justified to a large extent as protection for costly structures. When compared with an alternative such as sodding, the cost of seed and fertilizer is not excessive.

The authors give the following points to remember in establishing vegetation on these subsoils:

1. **FERTILIZE PROPERLY.** Use 50 pounds of N and 200 pounds of  $P_2O_5$  on most subsoil cuts of Monona-Ida-Hamburg soil association.
2. **SEED AT THE PROPER TIME.** In the spring seed before May 15. Don't waste seed by seeding later than this date. Seed fall seedings between August 15 and September 15. Use 5 pounds of alfalfa and 8 pounds of brome per acre.
3. **USE A LEGUME.** Use a legume in the initial seeding even though you wish to end up with a grass. Alfalfa is the best legume to use. To obtain a good stand, inoculate the legume seed. Bromegrass will take over within 2 years.
4. **PLANT THE RIGHT VARIETY.** Plant varieties of brome and alfalfa adapted to western Iowa--Auchenbach or Lincoln brome; Vernal or Ranger alfalfa.
5. **MULCH IS NOT NECESSARY.** It is expensive to obtain and to apply; it is cheaper to reseed several times than to use a mulch.
6. **NATIVE GRASSES ARE SLOW.** If you prefer native grasses, use sideoats grama, little bluestem, switchgrass, or sand lovegrass--in that order of suitability. Be prepared to spend more money for native grass seed than for brome and to wait 3 to 5 years for good stands.

ARS, USDA, Inform. Div., Washington 25, D.C.

## Mulching

Anonymous. BLACK MAGIC. Amer. Veg. Grower. 10(6): 13,40. 1962.

Marcus Dingler of Pecos, Texas, experimented with black plastic on 4 acres in 1961 and obtained three times the usual number of marketable cantaloupes, and four times the normal okra output. Following this, he planted a crop of sweetpotatoes.

Although the results were good when used on the other crops, the plastic mulch was most effective on cantaloupe. The fruit matured about two weeks earlier than usual and was more uniform in size. The plastic mulch prevented the serious problem of soil rot; aided moisture retention in the soil; lessened the salinity problem; and gave excellent weed control. Because the plastic mulch helped retain moisture in the field, the amount of irrigation water necessary for proper growth was reduced 25%.

In 1962, he machine planted 200 acres of mildew resistant #45 cantalope on 1.5 mil black plastic film 40 inches wide. Three or four seeds were planted at 18-inch intervals with rows spaced 76 inches apart.

No address given.

American Fruit Grower. PLASTIC MULCH SQUARES. Amer. Fruit Grower. 82(8):20. 1962.

Mulching young trees with black plastic squares has resulted in extra growth per season up to 100 percent. Mulched apple trees grew twice as fast as the unmulched blocks, with greater survival rates, in tests at Connecticut Agricultural Experiment Station in New Haven. With similar trials on peach, plum, cherry, and apple varieties, additional growth of 37 to 42% per season was reported in New York.

The black plastic squares have also been tested in other states and on other types of fruit trees with equally good results. The favorable results are attributed to elimination of weeds under the squares, increased soil warmth, and moisture retention with consequent irrigation savings.

The individual squares, which are supplied on continuous zip-off rolls, are serrated for easy detachment and perforated to the center of each square for speedy installation at the base of the tree. They are low in cost--a matter of pennies per tree. The squares can be anchored to the ground by applying a narrow band of soil around the edges, by covering the entire surface with 1/2 to 1 inch of soil, or by spading in the corners. Rocks or stones, where available, can also be used to anchor the squares against the wind.

Meister Publishing Co., Willoughby, Ohio.

## PLANT MANAGEMENT

### Pasture and Haylands

Hogan, W. H., Brooks, O. L., Beaty, E. R., and McCreery, R. A. EFFECT OF PELLETING COASTAL BERMUDAGRASS ON LIVESTOCK GAINS. Agron. J. 54: 193-195. 1962.

To secure data on the effect of pelleting Coastal bermudagrass forage on its utilization by beef steers an experiment was conducted at the Southeast Georgia Branch Experiment Station, Midville, Georgia.

Processing methods studied were: (1) Soilage (green chop hay); (2) artificially dried hay; (3) continuous grazing; and (4) pelleting.

Results obtained show that: (1) Pelleting the grass resulted in an increase in daily animal gains; (2) bermudagrass pellets were equal to alfalfa pellets as steer feed; (3) soilage and artificially dried hay were both inferior to pellets; (4) conventionally grazed animals gained at a higher rate during the first 60 days of the test than did animals eating soilage or artificially dried hay; (5) animals fed pellets consumed 23 percent more dry matter than those eating soilage or hay; (6) pelleted Coastal bermudagrass produced a pound of beef for less than 8 pounds of feed while more than 12 pounds of the same forage as hay or soilage were required to produce a pound of beef during a 60-day period; and (7) the feeding of pellets produced rapid gains throughout the season while conventional grazing failed to produce any appreciable gains after late July.

J. Paper 176 of Col. and Br. Expt. Sta., U. Ga., Col. Agr., Athens, Ga.

Hertz, L. B. EFFECT OF CERTAIN FERTILITY AND MANAGEMENT TREATMENTS ON THE GROWTH AND EARLY DEVELOPMENT OF TILLERS OF TWO VARIETIES OF SMOOTH BROMEGRASS. Agron. J. 54: 139-141. 1962.

The effects of certain fertility and management treatments on the early establishment and growth of a southern- and of a northern adapted variety of smooth brome grass (Lyon and Canadian certified) were determined.

The production of tillers during the seedling year was much higher on plots kept free of weeds than on those where weeds were clipped or where a companion crop was used.

No large difference was evident between plants from the weeds-clipped and companion-crop plots during the seedling year.

Production of tillers by Canadian brome grass was significantly greater than that of Lyon in the weed-free plots but not in the weed-clipped and companion-crop plots.

The production of tillers was not significantly increased by the addition of fertilizer. However, in Experiment B, the production of tillers by brome grass growing in the hand-weeded treatment was greatest when fertilized.

U. Wis., Madison, Wis.

Wright, N. ROOT WEIGHT AND DISTRIBUTION OF BLUE PANICGRASS, (PANICUM ANTIDOTALE RETZ.,) AS AFFECTED BY FERTILIZERS, CUTTING HEIGHT, AND SOIL-MOISTURE STRESS. Agron. J. 54: 200-202. 1962.

Root weights of blue panic grass under irrigation were studied. Distribution by weight showed approximately 55, 65, 70, and 75 percent of the roots to be present at depths of 6 inches, 1, 2, and 3 feet, respectively. All the rhizomes were located in the upper 6 inches. Root weights between 3 and 12 feet depths decreased progressively and represented approximately 25 percent of the total. Roots in the 0- to 2-foot zone (70%) assume a major role in forage production under irrigation where soil moisture is replaced as it is used. Observations suggest that the roots in the 2- to 12-foot zone (30%) assume greater importance in forage production when available moisture is limited in the upper 2 feet.

Root weights to a depth of 2 feet as affected by fertilizers, cutting height, and soil-moisture stress were investigated. Root weight was significantly increased by nitrogen fertilizer with maximum response at the 525-pound level of N. In the absence of phosphorus, a significant increase in root weight was obtained at the 525-pound N level only, whereas a significant increase in root weight resulted when 525 pounds of P was added with 175, 525, or 875 pounds of N. The remaining fertilizer treatments, P and K, and the interactions NK and PK were nonsignificant. A significant positive linear response for root weight was found as the cutting height was increased from 3 to 12 inches. Root weight showed a significant negative linear response as soil moisture was reduced to the wilting point at depths of 6, 12, 18, and 24 inches.

CRD, ARS, USDA, Tucson, Ariz.

Paden, W. R. LADINO CLOVER-TALL FESCUE ASSOCIATION AS AFFECTED BY SOIL TREATMENT AND GRASS POPULATION VARIABLES. Agron. J. 54: 190-192. 1962.

The effects of varying the thickness of the stand of fescue, the levels of nitrogen, and the levels of potassium upon the stand of clover in a clover-grass association were determined by clipping to simulate rotational grazing and by counting live stolons per meter line in the spring and fall.



The thickness of the stand of fescue had a very definite effect on survival of the clover. The medium thickness, or 12" spacing, was more favorable for maintenance of a desirable association than the 18" spacing with more clover, or the 6" spacing with less clover and more grass.

Varying the levels of nitrogen had very little effect on the clover stand by itself, but a very definite effect on the clover in the association. Increasing the rate of nitrogen application and thickness of the stand of fescue resulted in reduction in clover stand.

Varying the levels of potassium had a very significant effect throughout. It resulted in increased thickness of the stand of the clover by itself and also with the different thicknesses of the fescue. There were also less changes in the stands between seasons at the higher levels.

The interaction effects of variations in nitrogen and potassium levels were less than for each nutrient separately. The result of the nitrogen was to stimulate growth of the grass to the extent of reduction in stand of clover; whereas the result of potassium was to stimulate both growth of grass and clover and a high survival of clover stand.

Increasing the nitrogen and potassium levels resulted in production of higher total yields of forage and of forage varying in proportion of the two components.

Variation in thickness of fescue resulted in differences in both yields of forage and forage composition. The highest yield of forage and the forage of most desirable composition were produced by the intermediate thickness of the grass.

An intermediate thickness of the fescue followed by a medium level of nitrogen and high level of potassium provided conditions which were most favorable for production of high yields of forage and for maintenance of the clover-grass association.

S.C. Agr. Expt. Sta., Clemson Col., Clemson, S.C.

Scholl, J. M., and Brunk, R. E. BIRDSFOOT TREFOIL STAND ESTABLISHMENT AS INFLUENCED BY CONTROL OF VEGETATIVE COMPETITION. *Agron. J.* 54: 142-144. 1962.

Competition effects from weeds and companion crops as they influenced the establishment and subsequent productivity of birdsfoot trefoil were studied in field experiments at Ames, Iowa.

Dalapon (2,2-dichloropropionic acid) was very effective in controlling competition from annual grasses, and dalapon combined with 4(2,4-dichlorophenoxy) butyric acid, 4(2,4-DB), gave almost complete control of both grasses and annual broadleaf weeds in birdsfoot trefoil seedlings. The chemicals were applied 5 to 6 weeks after seeding.

A companion crop of oats significantly reduced the yield of birdsfoot trefoil in the year of seeding and the year following. This was true for all methods of management of the oats although there were differences between the management treatments. Oats as a companion crop produced the following amounts of dry matter (pounds per acre): when managed for grain, 4953; for hay, 4469; for "pasture 12-inch stage," 1127; and for "pasture 6-inch stage," 809.

Yields of trefoil in the year following seeding varied significantly and were more closely related to the size of the trefoil seedlings in the fall of the seeding year than to the number of seedlings at that time; plant populations varied from 17 to 40 plants per square foot in this experiment, seeded in 1957. Yields from the first harvest in the second year after seeding (1959) were not significantly different; a sufficient number of plants survived from very favorable initial stands to equalize the yields by the third year. This helps to explain the general observation that trefoil is slow to establish and usually does not produce satisfactory yields until the third or fourth year after seeding.

The use of these very promising herbicides must depend upon the relative costs, results of residue analyses, and action by the Food and Drug Administration and the U.S. Department of Agriculture. At the present time, these chemicals have not been released for use on forage crops where the forage may be fed to livestock during the year of application.

U. Wis., Madison, Wis.

Colville, W. L., and Torrie, J. H. EFFECTS OF MANAGEMENT ON FOOD RESERVES, ROOT ROT INCIDENCE AND FORAGE YIELDS OF MEDIUM RED CLOVER, TRIFOLIUM PRATENSE L. Agron. J. 54: 332-335. 1962.

The effects of seedling year fall management and the stage of maturity at first harvest on the persistence and forage yield of two varieties of red clover were studied.

Forage yields of Dollard were generally superior to those of Wisconsin Mildew Resistant. Dollard survived better into the second cutting year. This was probably due to a lower incidence of root rot in Dollard.

Clipping once in the fall of the seedling year as compared to clipping twice resulted in less stand reduction during the fall and winter of the seedling year, a lower incidence of root rot, and higher yields. No differences in percentage total available carbohydrate or in T.A.C. (Total Available Carbohydrates) per 100 roots were noted between the 2 fall clipping treatments. Longterm progressive deterioration of stands or plants was not found as a result of fall clipping.

Forage yields were highest when cuttings were made at the past full bloom stage of maturity, followed by 50 percent bloom, spring clipped, and late bud stages. In general, forage yield increased and crude protein content decreased with delay in harvest of the first crop. No carry-over effect was noticed in second-crop forage yields or quality. Plots cut in the late bud stage were generally lower in root rot incidence, higher in grams of T.A.C. per 100 roots, and had greater second-cutting stand survival than when harvested at the other stages of maturity.

Stand reduction depends greatly on the prevailing climatic conditions during the critical fall, winter, and spring periods. The ability of red clover plants to recover rapidly in the spring and to compete successfully with weeds appears to be as important as plant numbers in obtaining maximum yields.

Wis. Agr. Expt. Sta., Madison, Wis.

## Rangelands

Kucera, C. L., and Ehrenreich, J. H. SOME EFFECTS OF ANNUAL BURNING ON CENTRAL MISSOURI PRAIRIE. Ecology. 43: 334-336. 1962.

A 3-year study was conducted to observe the effects of annual spring burning on dry matter production and mineral composition of native prairie vegetation in central Missouri. There was a marked increase in growth on burned plots. Flower stalks of the principal grasses, Andropogon Gerardi, A. scoparius, and Sorghastrum nutans, were more numerous as a result of burning.

Factors to which greater yields in burned plots are attributed include earlier growth due to warmer soil temperatures in early spring, less shading, and greater availability of nutrients.

No significant differences were noted between burned and unburned plots in total ash and nutrient composition of seasonal growth. There were differences in total ash content of plant materials of varying age. Ash values for litter were higher than those for current growth. The ash composition of grass products became proportionately higher in silica as weathering progressed.

U. Mo., Columbia, Mo.

Linnell, L. D. SOIL-VEGETATION RELATIONSHIPS ON A CHALK-FLAT RANGE SITE IN GOVE COUNTY, KANSAS. *Kans. Acad. Sci. Trans.* 64: 293-303. 1961.

Soil properties and vegetation structure on a chalk flat range site in Gove County, Kansas were determined. Data concerning soils and vegetation were collected from a line transect extending eight-tenths of a mile across the site.

The area lies in the 15-to 19-inch rainfall belt, with the major portion of the precipitation falling during the growing season. Temperatures during 1959 were generally above normal while precipitation was below normal. Drought persisted through the first four months of the growing season with June showing the greatest precipitation deficit.

Nine profile descriptions were written at one-tenth mile intervals along the line transect. Soils were deep, light colored, friable silt loams, and light silty clay loams developed on colluvial fans below Niobrara Chalkrock bluffs. Constant deposition of chalkrock material from bluffs above maintain the soils in a youthful state of development.

Texture of the soils was determined by the hydrometer method. Samples were collected from each horizon at each profile site. Soils contained a high clay content, especially the second horizon, probably because of a high percentage of calcium carbonate.

Soils contained little organic matter, with surface horizons having the largest percentage. Soil pH ranged from 7.1 to 7.8 in the surface two horizons, which is a rather low pH for soils containing large quantities of calcium carbonate. Low pH may be due to the concentration of exchangeable potassium since an accumulation of soluble salts tends to cause a depressed pH. Calcium carbonate varied from 42.1 to 79.0 percent.

The water intake rate of the soils at three study sites was determined by cylinder infiltrometers and was found to vary considerably depending on soil properties and vegetation of the site. Where little bluestem was dominant, infiltration was considerably higher than where side-oats grama was dominant, primarily because of partially weathered chalkrock fragments in the soil supporting little bluestem. Vegetative cover was 16.4 percent.

The dominant species of grass was side-oats grama which made up 75.9 percent of the species composition with 67.5 percent frequency. Buffalo grass was the next most important species, occurring in 4.6 percent of the plots and averaging 7.1 percent of the composition. Salt grass ranked third in percentage composition with 6.3 percent, and had an average percentage frequency of 8.8. Little bluestem composed 3.2 percent of the vegetation with a frequency of 2.6 percent.

Yield of vegetation varied from 1,014.6 pounds to 3,764.7 pounds per acre depending on the area and associated species.

Average yield of the 20 samples was 2,348.7 pounds of forage per acre.

No address given.



## Plant Materials

Phares, R. E., and Rogers, N. F. IMPROVING SHORTLEAF PINE SEED PRODUCTION IN MISSOURI. *J. Forestry* 60: 322-324. 1962.

Shortleaf pine seed production is influenced significantly by stand density and competition from understory hardwoods. For stands of the age studied, optimum stocking for maximum seed production could be lower than 50 square feet basal area per acre--the lowest density studied in these experiments. Thinning from below or selectively leaves only the largest and best potential seed trees.

The treatments shown here to increase the seed crop also favor other management phases of a seed-production area. The recommended wide spacing between seed trees and understory hardwood control makes it easier to use mechanized equipment to collect seed, to cultivate the soil and apply soil amendments, and to carry out control measures against disease and insects.

Central State Forest Expt. Sta., FS, USDA, Columbia, Mo.

DeWitt, J. L., Canode, C. L., and Patterson, J. K. EFFECTS OF HEATING AND STORAGE ON THE VIABILITY OF GRASS SEED HARVESTED WITH HIGH MOISTURE CONTENT. *Agron. J.* 54: 126-129. 1962.

Seed of Manchar smooth brome grass and Delta Kentucky bluegrass was harvested at various moisture contents by direct combining and by simulated windrowing in 1959. The combine-harvested seed was bagged in burlap bags and allowed to heat. Samples were taken from 3 locations within the bags after the seed had begun cooling and again at the end of 2 weeks.

There was no significant difference in germination due to moisture at harvest in the simulated windrow-harvested seed, and this seed was consistently higher in germination than the combine-harvested seed.

Seed of Delta and Manchar combine-harvested at less than 25% moisture did not heat sufficiently to damage seed viability as long as free circulation of air was maintained around each bag. Combine-harvested Manchar seed did not reach peak germination until the moisture content dropped to 14% while the Delta combine-harvested seed reached peak germination at the 28% moisture level.

When the seed was left in the bags for 2 weeks after harvest, there was further decline in germination of the Manchar seed harvested at 25% moisture and of the two interior samples of the Delta seed for both harvests at 28% moisture. Manchar at less than 24% moisture and Delta at less than 22% moisture did not appear to be reduced in germination or seed weight by the longer storage period.

CRD, ARS, USDA, and Wash. Agr. Expt. Sta., Pullman, Wash.

## Woodlands

Choate, G. A. ESTIMATING DOUGLAS-FIR SITE QUALITY FROM AERIAL PHOTOGRAPHS. *Pacific Northwest Forest and Range Expt. Sta., Res. Paper* 45, 26 pp. 1961.

The feasibility of developing a technique for estimating site index of Douglas-fir in the Pacific Northwest, using aerial photos and topographic maps was investigated. Physiographic

features were used as indicators of site index. Analysis showed that although most of the features were highly significant as criteria for predicting site index, they explained less than one-third of its variation. Equations, using the physiographic features as independent variables, were shown to be useful for estimating site index by a double-sampling procedure--particularly in relatively inaccessible places.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

Hosner, J. F., and Leaf, A. L. THE EFFECT OF SOIL SATURATION UPON THE DRY WEIGHT, ASH CONTENT, AND NUTRIENT ABSORPTION OF VARIOUS BOTTOMLAND TREE SEEDLINGS. *Soil Sci. Soc. Amer. Proc.* 26: 401-403. 1962.

Current year seedlings of 14 bottomland tree species surviving 60 days of completely water-saturated soil conditions were compared to check seedlings grown under well-watered but nonsaturated soil conditions. Comparisons were made of the following: dry weight per seedling top, and contents of ash, N, P, K, Ca, and Mg. Based on root and shoot growth and nutrient absorption, the species are grouped according to their relative tolerances to water-saturated soil conditions as follows: Tolerant--Nyssa aquatica, Fraxinus profunda, Salix nigra, Fraxinus pennsylvanica; intermediate--Quercus palustris, Populus deltoids, Platanus occidentalis, Acer negundo, Acer rubrum, Acer saccharinum; and intolerant--Ulmus americana, Celtis occidentalis, Liquidambar styraciflua, Celtis laevigata.

It was suggested that the relative tolerances of different species of trees to soil saturation depended on the ability of root systems to grow under unaerated conditions; or on the ability to compensate for the poor aeration of the normal root system by producing an adventitious root system.

Va. Polytech. Inst., Blacksburg, Va.

Franklin, J. F. NOBLE FIR--A BIBLIOGRAPHY WITH ABSTRACTS. Pacific Northwest Forest and Range Expt. Sta. Res. Paper 46, 39 pp. 1962.

This bibliography on noble fir (Abies procera Rehd.) includes both North American and European references. The most important references have been abstracted. An article concerning California red fir and one concerning Shasta red fir are included, as their silvical characteristics are similar to noble fir's and these studies were considered especially significant.

Articles are listed alphabetically by author. A subject index is given along with a list of common and scientific names of tree species mentioned in the abstracts.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

Haney, G. P. SEEDBED SCARIFICATION AIDS REGENERATION OF SHORTLEAF PINE. *J. Forestry* 60: 400-402. 1962.

Scarification of the seedbed and a good supply of shortleaf pine seed resulted in an adequately stocked stand of reproduction with seven times as many seedlings as on an undisturbed seedbed. Percent stocking on the scarified seedbed was nearly four times as great as on the undisturbed seedbed. Seedling mortality was greatest during the first year, with the loss of about one-third of the initial seedling catch. There was no difference in the mortality rate between the scarified and undisturbed seedbeds.

The ratio of the number of seed required to establish one seedling was 50:1 for the scarified seedbed, and 392:1 for the undisturbed seedbed.

Scarification greatly reduced the hardwood competition. After two growing seasons, 54 percent of the scarified area was relatively free of competition.

Preparing a mineral soil seedbed in a good seed year provides the best opportunity for natural regeneration of a shortleaf pine stand in the Piedmont.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C.

Brown, J. H., and Carvell, K. L. GRASS CONTROL AROUND PLANTED TREE SEEDLINGS. J. Soil and Water Conserv. 17: 76-77. 1962.

The sodium salt of 2,2-dichloropropionic acid applied at a concentration of 0.07 pound per gallon of water proved effective in controlling grass sod around young pine and spruce seedlings. This concentration is adequate to give excellent control of sod and yet does no damage to the seedlings' foliage unless applied during a period of active growth. This herbicide proved more suitable than trichloroacetate or mineral spirits. The former caused considerable foliage damage while the latter gave control for less than 1 year.

Prior to planting, spots may be sprayed with a mixture of the sodium salt of dichloropropionic acid (0.25 pound per gallon of water) plus the acid ester of 2,4,5-trichlorophenoxyacetic acid (1 tablespoonful per gallon of water). This will control grasses, other herbs, and low shrubs. The effect of this spraying was evident after four growing seasons and this length of time was judged sufficient to allow satisfactory seedling establishment.

On old-field planting of yellow-poplar, grass sod may be eliminated by spraying with the sodium salt of 2,2-dichloropropionic acid; this results in improved foliage color and vigor.

W. Va. U., Morgantown, W. Va.

Pond, F. W., and Cable, D. R. RECOVERY OF VEGETATION FOLLOWING WILDFIRE ON A CHAPARRAL AREA IN ARIZONA. Rocky Mountain Forest and Range Expt. Sta. Res. Note 72, 4 pp. 1962.

In 1951, wildfire struck the Pinal Mountain area of east central Arizona. The fire was so hot that it killed all aboveground vegetation and left only charred stems and a thin layer of ashes. Before the summer rains began, the burn was aerially seeded to weeping lovegrass at the rate of 2 pounds per acre. Because of well-spaced, plentiful rains, a relatively good stand of lovegrass grew among the sprouting shrubs during the first summer. Many of the grass plants produced seed that germinated the following year and thickened the stand.

Chaparral in this area consists of shrub live oak (Quercus turbinella Greene), pointleaf manzanita (Arctostaphylos pungens H.B.K.), desert ceanothus (Ceanothus greggii A. Gray), sugar sumac (Rhus ovata S. Wats.), hollyleaf buckthorn (Rhamnus crocea Nutt.), skunkbush sumac (Rhus trilobata Nutt.), and Wright silktassel (Garrya wrightii Torr.). All except desert ceanothus and pointleaf manzanita sprout readily after burning. However, seeds of both of these species germinate quickly following burning and give rise to many seedlings.

Within 7 years, chaparral crown cover was approaching that of adjacent unburned areas. There was no significant difference in rate of shrub recovery on the exclosure studied and the adjacent grazed area.

Weeping lovegrass, seeded in 1951 immediately after the burn, developed a good stand during the first growing season and continued to increase in basal cover on the exclosed



area through 1956. It's basal cover was reduced on the grazed area, and was lower in 1956 than in 1952.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Romancier, R. M., and Brender, E. V. MANAGEMENT OF SMALL WOODLAND HOLDINGS IN THE GEORGIA PIEDMONT--A 12-YEAR REPORT. Southeastern Forest Expt. Sta., Sta. Paper 151, 12 pp. 1961.

Three woodlots representing many of the stand and site conditions found in small woodland holdings in middle Georgia were under sustained-yield management for a period of 12 years. The management practices followed could be applied by any small woodland owner: Good forestry practices were applied and proper stocking and good growth were promoted.

The objectives were for continuous yield of saw logs and pulpwood on an annual cutting cycle. The annual cut was set below the estimated annual growth to build up the initial stocking.

Harvesting operations were at first strictly improvement cuts and began early in 1949. Harvests were made annually in each woodlot through 1956, except in Farm Woodlot 2, which was converted in 1953 to a periodic harvest schedule.

Over the 12-year management period, an amount of wood equal to about half the 1948 cubic-foot volume was harvested from each woodlot.

The actual financial returns from the woodlots have been considerable, averaging \$77 per acre. There has also been a significant increase in the value of each woodlot. Comparing the initial and production values of the three woodlots, the compound interest rates earned are: (1) Farm woodlot 1--2.6 percent; (2) farm woodlot 2--6.4 percent; and (3) farm woodlot 3--9.2 percent. A portion of the increase in valuation is the result of the general business inflation, but much of the increase is directly related to the forest management practices used. A great many of the small woodland holdings in middle Georgia can be profitably managed for wood production. Initial investments are small while the potential returns are great.

Southeastern Forest Expt. Sta., FS, USDA, Ashville, N.C.

Stupnikova, A. N., Sudnitsyn, I. I., and Stupnikov, V. G. EFFECT OF THINNING ON THE GROWTH OF MASSIVE FOREST PLANTATIONS IN THE DRY STEPPE. Soviet Soil Sci. 5: 527-532. May 1961.

The thinning of oak-ash plantations on a watershed in the dry steppe resulted in a change of the soil moisture regime. Even though the total moisture losses from the soil remained at the former level during the growing period, the transpiration losses of the tree stand decreased and evaporation from the soil surface and transpiration by grass vegetation increased.

As a result of thinning, the moisture uptake of the tree stand from the upper soil layer decreased, while the uptake from deeper layers (below 20 in.) hardly changed.

Available soil moisture is used more slowly under thinned plantations than under dense ones.

Even though transpiration losses by the tree stand decreased, the amount of moisture used on the average on the transpiration of a single tree increased. There is a high positive correlation of ( $r = +0.83 \pm 0.15$ ) between transpiration losses of a single tree and the wood increment.

Regular thinning is required to improve the moisture availability to plantations on a watershed in the dry steppe. The degree of thinning should not be too severe to prevent grass vegetation from taking over and avoid an excessive increase of evaporation from the soil surface.

Amer. Inst. Biol. Sci., 2000 P. St. N.W., Washington 6, D.C.

Buckman, R. E. TWO PRESCRIBED SUMMER FIRES REDUCE ABUNDANCE AND VIGOR OF HAZEL BRUSH REGROWTH. Lake States Forest and Range Expt. Sta. Res. Note 620, 2 pp. 1962.

In the spring of 1960, a prescribed burning experiment was begun on the Cutfoot Experimental Forest located in north-central Minnesota. The study was installed beneath a stand of 90-year-old red pine which has an understory of brush. One of the main purposes of the experiment was to compare dormant season with summer burning, and annual with biennial burning.

Fires easily killed the above-ground portions of all brush regardless of the season of year or frequency of burning. Sprouting or resprouting of the brush followed, and the abundance and massiveness of the sprouts appears to be related to the season and frequency of burning.

Two annual summer fires have reduced the total number of stems per acre below that contained in the original stand. All other burning treatments have produced at least twice as many sprouts per acre as there were stems in the original stand; in the case of two annual spring fires, there are nearly four times as many sprouts as original stems.

The vigor and volume of regrowth is also affected by the season and frequency of burning, but the picture is complicated because the summer burns have not had as much time for regrowth as the dormant season burns.

Two annual summer fires have completely eliminated hazel sprouts from several of the milacre subplots on which measurements were made, a result not achieved by the other treatments. This effect on distribution, together with the data given on number and vigor of sprouts, suggests that subsequent annual summer fires will continue the deterioration and bring about the eventual elimination of hazel brush.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Gratkowski, H. J. USE OF HERBICIDES ON FOREST LANDS IN SOUTHWESTERN OREGON. Pacific Northwest Forest and Range Expt. Sta. Res. Note 217, 18 pp. 1961.

In southwestern Oregon, more information is needed on: (1) Absorption and translocation of herbicides in resistant brush species; (2) the best seasons and treatments for releasing ponderosa and sugar pines; (3) effects of various oils and other additives in carriers; and (4) economic limits for expenditures on herbicide programs.

Herbicides have already proved an effective silvicultural tool for preparing sites for reforestation and releasing conifers from brush competition in southwestern Oregon. Although much work remains to be done before we have adequate techniques for most of our important brush associations, usable prescriptions have already been developed for some brush types--especially for the tanoak-madrone brushfields of the Coast Ranges and Siskiyou Mountains. These treatments should be put into use and refined as additional information becomes available.

Herbicide programs should be used to prevent brush from taking over new cuttings. This should prove more profitable since sprouts generally can be controlled at lower cost than mature brush of the same species.

Table 1.--Suggested solutions of herbicides for foliage application on some common brush species in southwestern Oregon

Brush species	Herbicide	Pounds acid equivalent per 100 gallons	Carrier <sup>1</sup>	Comments <sup>2</sup>
Manzanita, hairy	2,4-D	2	Emulsion	Good control with one treatment.
Manzanita, hoary	2,4-D	2	Water	Good control with one treatment.
Manzanita, Howell	2,4-D	2	Emulsion	Good control with one treatment.
Manzanita, greenleaf	2,4-D	2	Emulsion	Good control after three treatments.
Ceanothus, deerbrush	2,4-D	2	Water	Good control with one treatment.
Ceanothus, snowbrush	2,4,5-T	2	Emulsion	Good control after two treatments.
Ceanothus, varnishleaf	2,4,5-T	4	Emulsion	Good control with one treatment.
Ceanothus, mountain white-thorn	2,4,5-T	2	Water	Good control after three treatments.
Chinkapin, golden	2,4,5-T	2	Emulsion	Fair control after three treatments.
Evergreenchinkapin, golden	2,4,5-T	2	Emulsion	Fair control after three treatments.
Tanoak, scrub	2,4-D	2	Emulsion	Fair control after three treatments.
Serviceberry, saskatoon	2,4-D	1	Water	Fair control after three treatments.
Oak, canyon live	2,4-D	2	Emulsion	Poor control after three treatments; aerial parts almost all dead; limited sprouting.

<sup>1</sup> Emulsions suggested are oil in water, containing 5 percent black diesel oil by volume.

<sup>2</sup> "Good control" indicates 80 percent or more of the shrubs dead and the remaining shrubs killed back. "Fair control" indicates 50 to 80 percent dead and the remaining shrubs killed back. "Poor control" indicates less than 50 percent of the shrubs dead after high-volume foliage spraying with ground spray equipment.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

MacAloney, H. J., and Schmeige, D. C. IDENTIFICATION OF CONIFER INSECTS BY TYPE OF TREE INJURY, LAKE STATES. Lake States Forest Expt. Sta., Sta. Paper 100, 42 pp. 1962.

Insects are a serious threat to the production of timber and other wood products in the Lake States. Many of these pests are native. Others have inadvertently been introduced. Both groups have often been extremely destructive to the forests.

The forest history of the Lake States is similar to that of many other regions of the country. Extensive stands of second growth followed the logging and fires and greatly altered type distribution. Today the spruce-fir type covers about 10 million acres, natural pine stands about 2½ million acres, and planted pine nearly 2 million. In addition, a large part of the 18 million acres of aspen-birch type is mature with an understory of balsam fir, which will eventually be the dominant species. In many localities, the fires have resulted in large contiguous acreages of one timber type such as jack pine.

Coniferous forests such as these--contiguous even-aged stands of one species or in a mixture of spruce and balsam fir--are especially vulnerable to insect attack. Defoliators, such as the spruce budworm and the larch sawfly, have periodically increased in abundance over the past several decades and have caused widespread tree mortality and reduction in growth. The budworm is again threatening thousands of acres of spruce-fir.

The latest information for identifying the more important insect pests of conifers in this region was presented. A key provides an additional guide. Some brief notes on life history and habits are given.



A few species causing damage in areas adjacent to the Lake States, but not yet found in this area so far as is known, are also discussed.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

## Windbreaks

Wilson, L. F. FOREST INSECTS AND DISEASES IN THE NORTHERN GREAT PLAINS--A SURVEY. Lake States Forest Expt. Sta., Sta. Paper 101, 28 pp. 1962.

The forest insect and disease problems of the Great Plains differ considerably from those of extensive forested areas. Native forests of the Northern Plains are limited largely to a few locations, mainly along water courses and a few upland areas where there is sufficient moisture. Extensive planting programs, undertaken primarily for establishing shelterbelts, alleviate in some degree this scarcity of trees and shrubs.

The most adaptable species have been selected for Plains plantings; nevertheless most of them do not fare as well as in their natural habitat. Those species that are outside their normal range are continually threatened by adverse environmental conditions. Lack of sufficient rainfall, severe winters, and adverse soil properties are but a few of the factors that prevent normal growth.

Under such conditions, trees are generally more vulnerable to attacks by insects and diseases. This is because: (1) Fewer attacks are needed to seriously injure these already weakened trees; and (2) some pest species are able to establish themselves and develop more rapidly on trees of poor vigor. Many shelterbelts are planted in single rows of one species. If this one species is damaged or destroyed, the entire shelterbelt will lose its effectiveness.

The multi-rowed mixed species composition of some shelterbelts also poses problems in the proper timing of chemical control operations. Many different pest species may infest the same small area at different times during the growing season.

In spite of the potential destructiveness of insects and diseases in shelterbelts, little information is available on their actual status today.

In 1960, a systematic survey was conducted to obtain information concerning the forest insects and forest diseases presently occurring in the Northern Great Plains region. The larger part of the survey was made in North Dakota and South Dakota, where shelterbelts are most concentrated. In all, 325 areas were examined. Of these, 285 were shelterbelts and windbreaks, 30 were naturally wooded areas, 5 were ornamental plantings on farms and in towns, and 5 were nurseries.

More than 80 species of insects were collected and identified from the tree and shrub species examined. Several diseases were identified, and cases of damage by unknown causes were occasionally observed.

Table, maps, and photographs.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

## Management of Coffee Plantations

O'Rourke, F. L. S. ENVIRONMENTAL FACTORS IN RELATION TO GROWTH AND YIELD OF COFFEE AND CACAO PLANTS. In ADVANCES IN HORTICULTURAL SCIENCE AND THEIR APPLICATION. Proc. International Hort. Cong. Nice, 1958. III: 154-157. 1962.

The adjustment of any species of crop plant from wild or semi-wild conditions to domestication under intensive methods of cultivation is facilitated by studies based on the

growth and yield response to such environmental factors as temperature, moisture, humidity, radiant energy, light, shade, and air movement. The conditions prevalent in the root zone, particularly with shallow-rooted plants, are also of marked importance.

Observations made in several countries in South East Asia and in tropical America indicate that yields of both cacao and coffee depend largely upon adequate light, temperature, humidity, and protection from wind for the above-ground portions of the plant and upon a relatively cool, moist, and well-aerated soil condition. While vegetative growth often proceeds fairly well under sub-optimum conditions, crop yield is dependent upon all contributing factors being present in adequate quantities and in balance with each other. Horticultural practices must be adjusted to maintain such optimum conditions in order to assure the highest yields at the lowest cost per unit of production.

Mich. State U., East Lansing, Mich.

## Fruit and Nut Crops

Martin, J. P., and Bitters, W. P. GREENHOUSE CITRUS REPLANT STUDIES WITH VARIOUS ROOTSTOCK SEEDLINGS AND ROOTSTOCK-SCION COMBINATIONS. Proc. Amer. Soc. for Hort. Sci. 80: 274-284. 1962.

A greenhouse study was made to determine the relationship of the rootstock or rootstock-scion combination of citrus plantings to growth retardation of subsequent plantings. Standard sour orange, Corona sweet orange, Sampson tangelo, Cleopatra mandarin, CES#2246 pink shaddock, Troyer citrange, Rangpur lime, Rubidoux trifoliate orange, Citrus macrophylla, and Citrus Volkameriana seedlings alone or grafted with a navel orange scion were tested. The magnitude of growth reduction caused by previous cropping to citrus varied from 0 to 92% and was influenced by the soil and the seedling or rootstock-scion combination of the original plantings and of the replants. The addition of a navel scion to a rootstock changed the magnitude of its growth retarding effects. In general, Rubidoux trifoliate orange and Troyer citrange made the best and Cleopatra mandarin the poorest relative growth when planted in old citrus soils. Trifoliate orange seedlings caused the least growth retardation of subsequent plantings. Cropping a virgin soil to citrus exerted a marked influence on the qualitative nature of the soil fungus population. The rootstock seedling or rootstock-scion combination exerted only a minor influence on these changes. The addition of a navel orange scion to a rootstock seedling sharply increased the relative numbers of Fusarium solani colonies developing on the plates.

U. Calif., Citrus Expt. Sta., Riverside, Calif.

Dickson, M. H. A NEW IDEA IN RHUBARB FORCING. Amer. Veg. Grower. 10(11): 9,20. 1962.

Rhubarb is not usually considered a muck crop, however, in 1959 about 30 rhubarb roots of various varieties were planted at the Experiment Station on the Bradford Marsh in Ontario, Canada.

Plant growth the first year on muck soils was extremely vigorous compared with plants of a similar age grown on mineral soil. It appeared that the crowns from one year's growth on muck soil might be equal to two-year-old crowns grown on mineral soil. To test this idea in May, 1960, 400 root cuttings of each of the varieties Victoria, Red Right Thru (a selection of Sutton's seedless), and MacDonald were planted. At the end of October, 1960,

half the roots were dug and exposed to cold temperatures for six weeks to break the rest period. They were then moved into a forcing shed at the Ontario Agricultural College.

The table indicates the results obtained for the two years with forced rhubarb.

# RESULTS OF RHUBARB FORCED FROM ROOTS GROWN ON ORGANIC SOILS

1960							
Variety	Age of Roots	No. Roots	Sq. Ft. Per Root	Percent No. 1 Gr.	Yield lbs. /Sq. ft.	Yield lbs. /Root	Yield lbs. /Acre.*
Victoria	1 Yr.	150	.7	92	4.8	3.5	16,000
Suttons	1 Yr.	150	.6	91	3.3	2.0	9,200
1961							
Victoria	1 Yr.	38	.5	82	7.6	3.8	17,500
Suttons	1 Yr.	72	.5	78	8.8	4.4	20,500
Victoria	2 Yr.	92	.8	77	6.6	5.6	25,750
Suttons	2 Yr.	156	.8	73	5.9	5.0	22,700
**Victoria & Suttons on Mineral Soil							
	2 Yr.	156	.6	90	6.9	4.6	21,000

\*Yield based on 4600 roots forced per acre, allowing 5 percent root failure.

\*\*Plants grown on mineral soil; all other roots grown on organic soil.

Rhubarb was forced economically after one year of growth in the field when the plants were grown on muck soils. The dollar returns per acre per year were higher when forcing was done after one year rather than two years. In addition, one-year-old roots reached the peak of production in a shorter time than did the two-year-old root, resulting in a shorter and more economic forcing period. This allowed a second crop to be moved into the forcing shed earlier than when two-year-old roots were grown. The one-year-old roots were smaller and more could be forced in a given area resulting in a higher yield per foot of forcing space.

The roots grown for only one year tended to produce paler colored petioles than those grown on mineral soil, however, this only became noticeable on the last picking from the one year roots, at which time the two year old roots still required two weeks in order to produce a full crop. If the temperature is properly controlled, good color can definitely be obtained from one year old roots grown on muck soils. It appears that roots grown on muck soil can be forced at a lower temperature than those grown on mineral soil and obtain equally good color.

Ontario Agr. Col., Guelph, Ontario, Canada.

Mai, W. F., and Parker, K. G. NEMATODES: HOW THEY AFFECT TREE GROWTH; WHAT TO DO TO PREVENT THEIR DEVELOPMENT. Amer. Fruit Grower 82 (2): 46, 48. 1962.

In orchard plantings on light textured soils in northeastern United States and adjacent areas of Canada, many cherry trees and some apple and peach trees have failed to make satisfactory growth. Many trees failed to become established and others made such poor growth that their production cannot pay for their care.



Failure of fruit trees has occurred on well-drained soil where good cultural practices were followed and no previously understood injurious factor was evident as the primary cause. Soil analyses usually have indicated a mineral nutrient supply considered as adequate and a satisfactory pH level. Organic matter content in problem orchards often has been low.

Experimental evidence and field observations indicate that, in some instances, lesion nematodes (Pratylenchus spp.) are primarily responsible for failure of the trees to grow. This type of plant pathogenic nematode lives inside feeder rootlets.

Large numbers of pin nematodes (Paratylenchus spp.) and dagger nematodes (Xiphinema spp.) also have been found associated with poorly-growing fruit trees. These pathogenic types, never entering the roots, feed from the outside by means of long needle-like mouth-parts. Root knot nematodes (Meloidogyne spp.), which cause knotted and distorted roots and poor growth of peach trees in warm areas of the world, have not been found attacking the roots of fruit trees in northeastern United States.

The feeding of nematodes and the damage probably done by fungi and bacteria, which enter through punctures made by the nematodes, result in death of the tender feeding or absorbing roots.

Severely attacked trees have short terminal growth and dieback of the twigs. Usually, the leaf color is nearly normal unless a nutrient deficiency is associated with the nematode problem. An individual affected tree may die after two or more years, or it may grow poorly over a long period of time. Under some conditions, affected trees may improve and grow in a more satisfactory manner after several years of poor growth. Trees affected by nematodes are more susceptible to damage by drought and by low temperatures.

Treatment of soil with nematocidal chemicals prior to planting has resulted in a reduction of nematodes in soil and roots, healthier and more extensive feeder roots, and increased top growth.

A number of chemicals, when applied to the soil, will kill the kinds of nematodes found in orchard soils. Only a few closely related organic compounds, however, including dichloropropene, ethylene dibromide, and 1, 2-dibromo-3-chloropropane are considered suitable for field application by growers at this time.

These compounds are liquids which vaporize in the soil and kill nematodes on contact. Usually, they are applied by tractor-drawn applicators and are introduced at least 6 inches deep in the soil in continuous lines by means of tubes inverted behind chisels. The chisels should be located not more than 12 inches apart. The openings made by the chisels should be covered with soil immediately after treatment. Equipment such as cultipackers and Scotch harrows have been used successfully for this purpose.

Soil temperature should be at least 60° F. at the time of treatment. The soil should be plowed several weeks prior to treatment so that any organic matter turned under will have decayed.

Cornell U., N.Y. State Col. Agr., Ithaca, N.Y.

## Field Crops

Norden, A. J. RESPONSE OF FIELD CORN VARIETIES TO PLANT POPULATIONS AND PLANTING DATES ON FLATWOODS SOIL. Soil and Crop Sci. Soc. Fla. Proc. 21: 213-220. 1961.

The response on flatwood soil of two hybrid corn varieties to five plant populations and two planting dates was studied at Gainesville, Florida in 1960-61. Results are reported on grain yield and agronomic characteristics, including plant height, ear height, ear weight, number of ears per plant, and percent of plants lodged.

In the March 1960 plantings, as plant population was increased from 5,000 to 25,000 plants per acre, grain yield increased from 106 to 132 bushels per acre. In 1961, the mean yield increased from 54 to 83 bushels per acre with an increase in population from 5,000 to 20,000 plants. Yield decreased 7 bushels as the plant population was increased from 20,000 to 25,000 plants per acre. The optimum plant population for flatwoods soils where moisture is usually not limiting might be higher than those recommended for the well-drained upland soils.

A significant date of planting x plant population interaction was obtained, indicating the optimum plant population for flatwoods soil varied depending on time of planting. Yields from a March planting in 1960 were increased significantly by population increases up to 20,000 plants per acre, while yields in the April planting were not increased significantly by populations above 10,000 plants per acre. The months of March, April, and May are usually lower in rainfall in Florida and the water table is in a downward trend which undoubtedly is a factor and indicates that on flatwoods soils, especially in late plantings, moisture can be a factor limiting corn yields. The percent lodging was a serious problem in the April planting, especially at the 25,000 plants per acre rates.

Both ear weight and number of ears per plant were decreased by increasing plant populations. Late planting resulted in a marked decrease in ear weight without appreciably affecting the number of ears per plant.

A highly significant plant population x variety interaction was obtained in regard to weight per ear in both the March and April plantings, indicating that different genotypes react differently to the environmental conditions existing in a high plant population.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Chapman, W. H. THE EFFECTS OF SPACING, HYBRIDS AND VARIETIES, FUMIGATION AND MULCHES ON YIELDS OF HIGHLY FERTILIZED CORN. Soil and Crop Sci. Soc. Fla. Proc. 21: 206-213. 1961.

Exploratory studies were conducted in 1960 and 1961 to study the effects of plant populations, hybrids and open-pollinated varieties of corn, soil fumigation, mulches, and bedding on highly fertilized field corn.

Populations higher than 20,000 plants per acre did not produce increased yields. With high populations, there were increased lodging, decreased ear size and a pronounced reduction in number of ears per stalk.

Yields of Coker 67 hybrid were significantly increased by thick populations. The plant populations used did not affect the yields of the open-pollinated varieties. There was a greater decrease in prolificacy of the open-pollinated varieties at close spacings as compared to the hybrids.

Yields on plots fumigated with methyl bromide were significantly higher than from unfumigated plots. Percent root lodgings was lower and the corn appeared more uniform and even in height in the untreated plots.

There was no significant difference in yields from plots mulched with pine straw, black plastic, or a white opaque material.

There was no visible difference in the root systems and no significant difference in yield between corn planted in a furrow and on a bed.

Yielding capacity of the hybrid, lodging, and root development and distribution appeared to limit yields. High fertility levels were not economical.

North Fla. Expt. Sta., Quincy, Fla.

Russ, P. L., and Bell, F. F. PRODUCTIVITY OF FOUR SELECTED TENNESSEE SOILS IN TERMS OF CORN YIELD. *Agron. J.* 54: 164-167. 1962.

Corn yields were obtained on four soils (Robertsville sil, Etowah sil, State 1, and Congaree 1) during 1957. Plant populations ranged from 4 to 28 thousand plants per acre. Nitrogen treatments ranged from 0 to 300 pounds per acre. To allow for observable differences among soils, the range of treatments was different for each soil. P and K were applied at constant rates of 235 and 448 pounds per acre, respectively.

The population and nitrogen combination resulting in the highest yield was different for each soil. Corn yields were affected more by population increments than by applied nitrogen. Yields on the four soils ranked as follows: Congaree > State > Robertsville > Etowah. Late seed germination on Etowah resulted in ear formation during a period of soil moisture stress. Thus yields were adversely affected.

Jr. Author, U. Tenn., Knoxville, Tenn.

Briggle, L. W., and Reitz, L. P. WHEAT IN THE EASTERN UNITED STATES. U.S. Dept. Agr., Agr. Res. Serv. Agr. Inform. B. 250, 28 pp. 1962.

About one-fourth of the wheat grown in the United States is produced in the eastern region, which includes all the States east of the Mississippi River, Louisiana, and parts of Missouri, Arkansas, and Texas.

The wheat varieties suitable for growing in different areas are described and suitable production methods and practices, such as early preparation of the soil, fertilization, and timely seeding to evade possible damage from the Hessian fly and winterkilling are discussed. Diseases and insects and their control also are discussed.

ARS, USDA, Inform Div., Washington 25, D.C.

Chumney, W. T., and Vermeer, J. COSTS OF CROP PRODUCTION, BY SIZE OF FARM, CENTRAL COTTON-TOBACCO AREA OF NORTH CAROLINA. U.S. Dept. Agr., Econ. Res. Serv. Agr. Econ. Rpt. 14, 75 pp. 1962.

Costs per pound of producing tobacco in 1956 were 16 percent lower on large farms in the central cotton-tobacco area of North Carolina than on small farms in the same area, and for cotton they were 20 percent lower on the large farms. Costs of producing corn were more than 40 percent lower and costs of producing soybeans, oats, and wheat were more than 50 percent lower on the large farms. Costs of producing cotton, tobacco, and corn were lowest on the large single-unit farms; costs of producing soybeans, oats, and wheat were lowest on large multiple-unit farms (farms with croppers).

These conclusions are based on a study of 267 farms selected at random and surveyed in 1957. The cost estimates exclude charges for land and management, but they include charges for all labor at wage rates paid to hired labor.

Farms ranged in size from 4.2 to 305 acres of cropland. Separate analyses were made of single - and multiple-unit farms--that is, farms without croppers and those with croppers. Each of these classes of farms was divided into four size groups. The small - medium-sized farms in each class include farms in the lowest and middle third of all farms in the sample arrayed by acreage of cropland. The medium-large and large farms together comprise the one-third of the largest farms in each of their respective classes. The two groups of large farms include the fewest number of farms and span the widest range in acreage of cropland.



Much of the difference in costs reflected the degree of mechanization associated with size, which on the larger farms had reduced labor requirements per acre and per unit of production. Total power and machinery costs were higher on the larger farms, but costs per acre and per unit of production were lower because fixed costs were spread over a larger volume of production.

MOS, USDA, Inform. Div., Washington 25, D.C.

Staff Writer. SOUTH FLORIDA'S BIG SUGAR BOOM. Land and Water Contracting 4(6): 6-9. 1962.

There is a sugar boom in south Florida on the muck flats of the Everglades south of Lake Okeechobee. In early 1962, an army of draglines, earthmoving machinery, landclearing machinery, and planting crews were working around the clock to turn a black muckland into a rich new sugarland.

Seven new sugar mills were rising out of the swamplands around the southern perimeter of Lake Okeechobee. An estimated \$100 million was invested in refineries and cane land to supply them. In addition to new land that was wrested from the Everglades, thousands of acres formerly in pasture and croplands were pushed into cane production.

South Florida's net acres in cane for sugar production in 1961 was approximately 32,000. By the end of 1962, an estimated 200,000 acres will be growing cane. Florida produced 1.6 million tons of cane in 1962 and the output in 1962 is expected to reach seven million tons.

The expansion is the result of many factors, but industry leaders credit the following as being the major reasons for south Florida's rapid development as a cane-growing region:

1. The development of a special variety of cane, C141-223, an early maturing, high-sucrose-content and cold-resistant cane which has greatly increased the area's cane-growing potentiality.
2. A relaxation of the mainland sugar quota caused in part by deficits in offshore sugar quotas and the embargo against Cuban sugar.
3. The combined enterprise of American capital and exiled Cuban sugar experts, who were willing to expand America's sugar production and make it less dependent on outside sources.
4. The hope that domestic sugar growers will get larger quotas.

Land and Water Contracting, P.O. Box 2268, Montgomery 3, Ala.

## Vegetable Crops

Gavett, E. E. TRUCK CROP PRODUCTION PRACTICES--BROWARD AND PALM BEACH COUNTIES, FLORIDA--LABOR, POWER, AND MATERIALS BY OPERATION. U.S. Dept. Agr., Econ. Res. Serv. ERS-79, 31 pp. 1962.

The third in a series of 12 publications containing information on labor requirements, production practices, and costs involved in the production of truck crops for fresh market and for processing is presented.

Late in 1959, information regarding the 1958-59 production of truck crops was obtained by personal interview with operators of 146 farms. The survey farms represented a 68-percent sample of all farms, in the two counties that harvested truck crops for sale. On the average, these farms had 383 acres of cropland. Because of double- and triple-cropping of

land, vegetables were grown on 512 acres. In general, farms in the area produce two or more different truck crops; and the larger farms are the more diversified. Information on six vegetables grown for the fresh market are presented.

Tables and graphs.

MOS, USDA, Inform. Div., Washington 25, D.C.

Porte, W. S. COMMERCIAL PRODUCTION OF TOMATOES. U.S. Dept. Agr. F. B. 2045, 48 pp. Rev. 1963.

The tomato has now become one of the most popular vegetable crops and ranks next to potatoes in total value. Annually, 170,000 to 200,000 acres are now grown for the commercial production of 32 to 33 million bushels of fresh-market tomatoes with a market value of approximately 135 million dollars in 1960. The tomato crop for processing varies from about 3 1/2 to 4 million tons a year, with a market value of 100 million dollars, and requires about 280,000 acres of fertile soil for its production.

This is a "culture and care" publication for the commercial production of tomatoes in the United States.

ARS, USDA, Inform. Div., Washington 25, D.C.

Baumgardner, R. A., and Scott, L. E. FIRMNESS OF PROCESSED SWEET POTATOES (IPOMOEA BATATAS) AS AFFECTED BY TEMPERATURE AND DURATION OF THE POST-HARVEST HOLDING PERIOD. Proc. Amer. Soc. for Hort. Sci. 80: 507-514. 1962.

Firmness of processed sweet potatoes as affected by temperature and duration of short post-harvest holding periods was investigated. Duration of the holding period varied from 2 days to 2 weeks and temperatures ranged from 0° to 30°C. Firmness was measured by both subjective and objective methods. The following conclusions are based on the results obtained during 3 years from tests with 6 different lots of sweet potatoes: (1) A firm product resulted when roots were processed within 24 hours after harvest; (2) holding temperature prior to processing had a marked effect upon firmness; (3) a soft canned product was associated with a holding temperature of 15° to 30°C; whereas, a firm product resulted when the canning stock was held at 0°C; and (4) varietal differences in response to the effect of storage were evident.

U. Md., College Park, Md.

Larsen, F. E. EXTERNAL AND INTERNAL (BLACKSPOT) MECHANICAL INJURY OF WASHINGTON RUSSET BURBANK POTATOES FROM FIELD TO TERMINAL MARKET. Amer. Potato J. 39: 249-260. 1962.

A study was made to determine the primary source of injury to Russet Burbank potatoes in Washington. The study was divided into three main parts according to who controlled a particular phase of handling--the grower, the shipper, and the railroad. Samples were taken from 17 growers, 9 shippers, and 3 railroad carloads of potatoes.

At the shipping point (after harvest and grading), 78% of the potatoes having external injuries were injured by the grower. Grading more than doubled slight and moderate injury over that contributed by harvest, but serious injury was increased only from 4.7 to 5.6%. The total amount of externally injured potatoes was increased from about 38 to 48% by grading. Seventy-eight percent of the tubers affected by blackspot were injured during harvest. Grading nearly doubled the number of spots per sample, but the spot intensity was increased only from 3.0 to 3.6. The total number of potatoes affected by blackspot was increased from 42 to 54% by grading.

Different growers and shippers differed significantly in the amount of injury that they produced. As a general rule, injury tended to decrease as the season progressed.

A good estimate of external injury caused by shipping was not obtained. Eighty-three percent of the tubers affected by blackspot were affected before shipping. Shipping increased the number of spots per sample by about 50%, but the spot intensity was increased only from 3.6 to 4.1.

The harvesting operation controlled by the grower was the greatest source of mechanical injury.

Wash. State U., Pullman, Wash.

Harrison, M. D. POTATO RUSSET SCAB, ITS CAUSE AND FACTORS AFFECTING ITS DEVELOPMENT. Amer. Potato J. 39: 367-368. 1962.

Potato russet scab in Minnesota is caused by a species of *Streptomyces* similar to, but different from *Streptomyces scabies*, *S. tenuis*, and *S. marginatus*.

The pathogen was readily isolated by placing thin sections of diseased tissue on water agar, but could not be isolated by the usual dilution techniques.

In the greenhouse, the disease developed best at soil moisture contents of 60% or more of field capacity and at 23° to 26° C.

The pathogen survived at least 6 months in infected tubers in storage, but invaded autoclaved soil from infected seed very slowly.

In field tests, very little resistance to russet scab was found among 10 commercial potato varieties and 5 selections resistant to common scab. Some clones selected for resistance to common scab were very susceptible to russet scab.

U. Minn., St. Paul, Minn.



# ECONOMIC AND SOCIAL ASPECTS OF SOIL AND WATER CONSERVATION

## Costs and Returns

\* COSTS AND RETURNS: \*\* U.S. Dept. Agr., Econ. Res. Serv. \*\*\*

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Goodsell, W. D., and Gray, J. R.	WESTERN LIVESTOCK RANCHES, 1961.	FRC-1, 10 pp. 1962.
Muck, R. J.	COMMERCIAL DAIRY FARMS; NORTH- EAST AND MIDWEST, 1961.	FRC-2, 10 pp. 1962.
Shugars, O. K.	COMMERCIAL TOBACCO FARMS; COASTAL PLAIN, NORTH CAROLINA, 1961.	FRC-3, 5 pp. 1962.
Stoddard, E. O.	COMMERCIAL EGG-PRODUCING FARMS, 1961.	FRC-4, 5 pp. 1962.
Shugars, O. K., and Bondurant, J. H.	COMMERCIAL TOBACCO-LIVESTOCK FARMS, 1961.	FRC-5, 6 pp. 1962.
Rosenberry, P. E.	COMMERCIAL CORN BELT FARMS, 1961.	FRC-6, 5 pp. 1962.
Hurd, E. B.	COMMERCIAL WHEAT FARMS; PACIFIC NORTHWEST, NORTHERN PLAINS, AND SOUTHERN PLAINS, 1961.	FRC-7, 8 pp. 1962.
Brown, W. H.	COMMERCIAL COTTON FARMS, 1961.	FRC-8, 10 pp. 1962.

Economic Research Service. FARM COSTS AND RETURNS: COMMERCIAL FARMS BY TYPE, SIZE AND LOCATION. U.S. Dept. Agr. Econ. Res. Serv. Agr. Inform. B, 230, 97 pp. Rev. 1962.

A continuing nationwide study of costs and returns on farms and ranches by type and size in some of the important farming regions of the United States, conducted under the general supervision of Wylie D. Goodsell of the Economic Research Service. Objectives, methodology, procedure, and terms are uniform for all areas covered in the study.

Summary statistics for all types of farms in the series are presented in the annual report, Agriculture Information Bulletin No. 230, Revised, 1962. In this annual report, information is given for 1961 with comparisons with 1960 and 1959, and with the period 1957-59.

Tables, graphs, and maps.

MOS, USDA, Inform. Div., Washington 25, D.C.

Cooperative Report. A GRAPHIC SUMMARY OF LAND UTILIZATION. 1959. U.S. Bur. Census, U.S. Census Agr. V (6): 1-48. \$0.40. 1961.

Data available from the 1959 Census of Agriculture and information collected from other Federal agencies was used to present graphically the land use situation in the Nation as it exists today and to evaluate some of the changes that are taking place. Compilation and summarization of information about the use of land resources was completed.

The historical continuity in the collection, compilation, and interpretation of data about the uses of land in the United States has proved invaluable in the study of present land resource problems. Planning for future growth is also aided by the existence of reasonably uniform information about major land uses in the past 50 years.

The present extent, location, and productivity of land used for different purposes is graphically presented. Such information is needed for the analysis of present and prospective agricultural and general economic conditions for the country as a whole and also for different areas of the country. The present attention being given to area redevelopment in the United States is an example of the need for careful examination of real differences in the utilization of resources. A graphic presentation of land use data can serve effectively in bringing about a better understanding of the basic facts about land resources and their use.

Maps, tables, and graphs.

Supt. Doc., U.S. Govt. Printing Off., Washington 25, D.C.

### **Institutional, Educational, and Social Factors Affecting Conservation Farming**

Vlasin, R. D., Pendleton, W. C., and Hedrick, J. L. THE EFFECTS ON FARM OPERATING UNITS OF LAND ACQUISITION FOR CONTROLLED-ACCESS HIGHWAYS. U.S. Dept. Agr., Econ. Res. Serv. ERS-69, 80 pp. 1962.

How farmers adjust to the loss of part of their real estate to highway rights-of-way was studied. The 3-year history of 80 farms crossed by Iowa Interstate Route 35 was examined. Operators were interviewed concerning certain features of these farm operating units for the crop year 1956--the crop year immediately preceding the right-of-way taking--and for the crop year 1959. Data on significant changes in intervening years were collected. To provide a control to help in isolating the effects of the highway taking, an additional group of 82 farms in the area was selected by laying out a hypothetical right-of-way parallel to, but 3 miles distant from, the study segment. Operators in this "control" group were asked the same questions as the operators in the "taking" group, and the data from the two samples were then compared.

The 33 miles of Interstate 35 examined took all or part of six sets of farm buildings and just under 7 percent of the farmland in the 80 sample operating units. Voluntary sales of excess land to the Highway Commission and the resale of some of this excess land to sample farms raised the decrease in average size of farm to about 10 percent. Despite this loss of land from highway taking and sales of excess, taking-group farms between 1956 and 1959 showed approximately the same rate of increase in average acreage as the control-group farms. More than half, however, failed to regain their 1956 acreage.

The taking-group farms showed a substantially higher rate of disappearance over the study period than did the control-group farms. Three-fifths of the former were involved in real estate transactions, compared with one-third of the latter. The tenure pattern and the rate of turnover of farm operators showed no apparent differences between the groups. Differences in the use of hired labor and in the off-farm work of the farm family were in the direction expected, but they were not large. Both groups showed considerable variability as to size of crop and livestock enterprises. The taking group showed greater variability for crop enterprises, but little difference was apparent in the overall variability of livestock enterprises. No noteworthy differences in machinery investment were detected.

The highway substantially increased the dispersion of the land operated by taking-group farms, the number and acreage of the separated parcels and the distance of these tracts from the farm headquarters. While the Highway Commission played the major role in helping farmers to dispose of separated tracts, many such tracts were retained in the farm units. Others were disposed of through normal market channels.

Tables.

MOS, USDA, Inform. Div., Washington 25, D.C.

Rush, J. D. FARM ACCIDENTS IN THE UNITED STATES. U.S. Dept. Agr., Econ. Res. Serv., Agr. Econ. Rpt. 17, 62 pp. 1962.

The number of farm-accident fatalities is not declining in proportion to the decline in farm population. The annual mortality from farm accidents is estimated at from 60 to 70 per 100,000 of farm population. Nonfatal injuries, including both lost-time and no lost-time accidents, occur to about a third of the farm population annually. The lost-time injuries involve about 19 percent of the farm population; while the more serious nonfatal accidents, those resulting in permanent disabilities, destroy or reduce the earning power of about 3 percent of the farm population annually.

Rural environmental situations are more hazardous than urban situations. Farms are isolated, with little supervision of work and not much opportunity for an injured person to obtain first aid promptly. Secondary highways are often hazardous. Even on the most improved rural highways, traffic is less controlled than on urban streets. The high rate of accidents to farm people is also related to the pattern of farm work, which is more of a family job running more nearly around the clock than the job of a wage earner in town.

Accident rates are high among our farm youth. For the United States more than half of the annual mortality to young people between the ages of 15 and 24 is due to accidents.

Perhaps 80 percent of our farm accidents result from carelessness or failure to deal with hazards safely. Many accidents are avoidable.

Motor vehicles are listed as the agency of injury most frequently associated with accidents to farm people. Traffic accidents account for many of the serious injuries of farm people while they are off their farms. Farm machinery was the agency most frequently associated with accidents occurring on farmland. Falls were most frequently associated with home accidents.

Farm accidents are at their peak in June, July, and August--the most active period of crop production and harvest.

The economic cost of farm accidents is unknown, but it is believed that hospitalization and medical treatment account for less than a fourth of the total cost. Little is known about the economic loss of wages or production, which probably accounts for a considerable part of the total cost. The indirect costs of industrial accidents are about 4 times the direct cost.

It is difficult in many respects to make comparisons or pool data from various "spot" studies. A uniform report form, with standardized definitions, is needed. Such a report form and definitions would permit comparison of basic factors among areas and time periods, promote a better understanding of the farm accident problem, encourage local studies, and perhaps point to more effective ways of reducing these accidents.

MOS, USDA, Inform. Div., Washington 25, D.C.



Conservation Needs Inventory Committee. AGRICULTURAL LAND RESOURCES CAPABILITIES, USES, CONSERVATION NEEDS: A DIGEST OF THE NATIONAL INVENTORY OF SOIL AND WATER CONSERVATION NEEDS. U.S. Dept. Agr., Soil Conserv. Serv. Agr. Inform. B. 263, 31 pp. 1962.

The National Inventory of Soil and Water Conservation Needs presents new facts about the Nation's private agricultural land and its needs for conservation treatment. The charts and maps portray the major findings for the 48 mainland States. Corresponding data for Alaska and Hawaii and totals for the 50 States appear in tabular form at the back of the book.

Privately owned rural land makes up 68 percent of the U.S. mainland. This plus land owned by States and other local governments brings the total of agricultural land included in this Inventory to roughly 1 1/2 billion acres or 76 percent of the mainland area.

In 1958 the private agricultural land of the 48 mainland States was used as follows: 31 percent for cropland (447 million acres); 33 percent for pasture and range (485 million acres); 31 percent for forest and woodland (450 million acres); and 5 percent for other uses (66 million acres).

About equal amounts, or one-fifth of the total, are in each of classes II and III, land suitable for regular cultivation with simple or complex conservation treatments. Another fifth is in each of classes VI and VII, land suitable for uses under permanent vegetation with moderate and severe restrictions in use.

A reserve of nearly 240 acres (classes I to III) now in pasture and woodland is suitable for regular cultivation when needed. Altogether, 637 million acres is suitable for regular cultivation. Another 169 million acres is marginal for the common farm crops but is suitable for occasional cultivation if carefully managed. (class IV).

About 36 million acres is in land-capability class I which has few limitations in use.

Cropland now includes 25 million acres of land not suitable for regular cultivation (classes V to VIII).

Some 49 million acres of class IV land now in cultivation presents a continuing management problem; much of it might better be converted to permanent vegetation.

The dominant factors limiting capability of land for agricultural use and presenting problems of soil and water conservation are: Erosion on 53 percent of problem acreage (738 million acres); excess water on 17 percent (246 million acres); unfavorable soil on 25 percent (352 million acres); and adverse climate on 5 percent (75 million acres).

Local committees estimated that, under the influence of agricultural and land use programs in 1958, 42 million acres of cropland, 32 million acres of pasture and range, 29 million acres of forest and woodland, and 14 million acres of other land are expected to change to other uses by 1975.

A net of 15 million acres is expected to go out of private agriculture to urban or other uses.

The 101 million acres expected to shift to new uses between 1958 and 1975 will need establishment of new conservation practices.

Sixty-two percent of our present cropland (272 million acres), almost three-quarters of the private pasture and range land (364 million acres), and more than half of the private forest and woodland (241 million acres) needs conservation treatment.

Of the more than 12,700 creek-size watersheds in the U.S. mainland, about 8,300 need project action to deal with problems requiring treatment beyond the ordinary means of individual land owners. The most widespread types of watershed problems needing project action are: Reduction of flood damages in 6,343 watersheds; control of critical erosion

areas in 4,651 watersheds; drainage in 3,931 watersheds; and irrigation development in 2,611 watersheds.

Tables, maps, and graphs.

SCS, USDA, Inform. Div., Washington 25, D.C.

Soil Conservation Service. SOIL CONSERVATION AT HOME: TIPS FOR CITY AND SUB-URBAN DWELLERS. U.S. Dept. Agr., Soil Conserv. Serv. Agr. Inform. B. 244, 29 pp. 1962.

The United States is becoming an urban nation. Nearly 9 out of 10 people live in cities and towns. Urban and built-up areas occupy nearly 50 million acres.

With population growing 3 million a year, land is going out of agricultural use at a net rate of 1 million acres a year. For each new family needs, on the average, about an acre of living space, transportation, and service facilities.

This growing acreage of urban and suburban land poses new conservation problems. The information and experience gained by the Soil Conservation Service in working with farmers and ranchers can be of value to those using land for other purposes. This publication makes some of that information available to urban and suburban residents.

SCS, USDA, Inform. Div., Washington 25, D.C.

Conservation Needs Inventory Committee. BASIC STATISTICS OF THE NATIONAL INVENTORY OF SOIL AND WATER CONSERVATION NEEDS. U.S. Dept. Agr. Stat. B. 317, 164 pp. 1962.

The National Inventory of Soil and Water Conservation Needs was conducted by the U.S. Department of Agriculture (USDA) cooperating with the land-grant colleges and other Federal, State, and local agencies. Its purpose was to provide the Department and other land-use planning and conservation agencies with "reasonable estimates of the magnitude and urgency of the various conservation measures needed to maintain and improve the country's productive capacity for all the people." The Department and its cooperating agencies have "constant need and use for information that can be gained only through a national inventory of soil and water conservation needs."

This volume contains the basic statistics of the Inventory. It includes the following data about four major aspects of the Nation's agricultural land: (1) Land capability, by class and subclass; (2) land use, actual in 1958 and expected in 1975; (3) conservation treatment needed on land in each land use; and (4) small watershed projects needed.

The part of the Inventory dealing with land capability, land use, and with conservation needs is concerned specifically with all rural land outside of Federal ownership--privately owned land, Indian land, and land owned by States, counties, and municipalities. This information, with the timber resources review, gives the Department basic information about all the land on which the USDA is authorized to carry on conservation and land use programs.

Since effective watershed treatment requires consideration of all land--whether private or public, rural or urban--draining to a stream, the watershed inventory includes Federal land and all water areas as well as the non-Federal land covered in the rest of the Inventory.

Soil surveys of statistically selected sample areas in every county began in 1957 and were completed in 1960. Statistical laboratories processed the resulting data and expanded

them to represent the entire acreage included in the Inventory. Conservation Needs Inventory Committees in each county and State made their estimates according to procedures established by a national Inventory committee, made up of representatives of eight agencies of the Department of Agriculture.

Data on all items included in the Inventory are summarized for each of the 50 States, Puerto Rico, and the Virgin Islands, for each of 10 economic regions, and nationally for the 48 mainland States and for the 50 States.

Tables and maps.

SCS, USDA, Inform. Div., Washington 25, D.C.

## BIOLOGY

### Fish

Jones, F. MINES + MANAGEMENT = MORE FISHING. Fla. Wildlife 15(11): 16-19. 1962.

Polk and East Hillsborough Counties in Florida produce 72 percent of the phosphate mined in the United States and one-third of all that mined in the world. These mines produce employment directly for more than 6,000 people the year round.

These mines have produced some of the best bass fishing in the country ever since the first pit was dug back in the late 1800's. Probably because of the high dissolved mineral content of the water, the mine fish grow large and rapidly. Under natural conditions, the phosphate mines have become nationally famous spots for big fish of all fresh water species native to Central Florida--and oddly enough, produce some salt water species.

But a new day is dawning now for mine fishing. No longer will the fishing depend on the vagaries of nature. Man and industry are stepping in with a high reclamation program designed to do away with the ugly wastelands left behind the mining operations, and to make them over into beautiful residential sections, fertile acres of fruit and pastures, and some of the most productive, unusual, and attractive recreational areas in the country.

Under development and management right now, solely for fishing and other allied recreational uses, are more than 1,200 acres of this former wasteland.

The Game and Fresh Water Fish Commission's Fisheries Management Division has already opened to the public its first section of the 500-acre Pleasant Grove Fish Management Area located in eastern Hillsborough County.

The newest and largest of these recreational reclamation projects is the Saddle Creek Park Area.

No address given.

Anonymous. FUNDAMENTALS OF FISH MANAGEMENT. . . THE TRUTH ABOUT STOCKING. Ga. Game and Fish 11(1): 8-9, 29-30. 1962.

Planting warmwater fingerlings serves a good purpose in the following instances:

1. To stock new waters, especially farm ponds and new public fishing lakes.
2. Reintroduction of fish in lakes depleted by fish kills.



3. Introduction of species not already present, where such introduction is desirable.
4. Restocking of waters from which existing fish populations were removed through use of chemicals or draining.

The stocking picture for warmwater and coldwater fish differs rather decidedly. Trout can be raised to catchable size at a much lower cost than would be needed to raise bass or other game fish to a size where they would be attractive to anglers.

In numerous waters we now have good trout fishing only by planting catchable-sized fish. In most Georgia trout streams, it is a case of having put-and-take stocking or having no trout fishing at all. Such stocking is justified only on heavily fished waters where a big percentage of stocked fish will be retaken by anglers.

In general, stocking with coldwater species may be expected to benefit fishing under these circumstances:

1. Stocking suitable lakes where trout have no spawning areas.
2. Restocking lakes or streams with fingerlings after removal of existing fish populations by use of rotenone or other methods.
3. Stocking with catchable sized trout. This is the only method of providing good trout fishing in waters that are heavily fished because usually they are not capable of raising enough fish naturally to supply the demand.

In fertilized ponds, biologists recommend 100 bass and 1,000 bream or shellcrackers per acre. For unfertilized ponds, only about one-half of that number is required since the food supply is limited.

It's a good idea to eliminate all other fish in impoundment before stocking. This helps insure fish population balance.

One word of caution: The pond should not be fished until the bass have spawned, which is usually about one year after stocking.

Stocking isn't a cure-all. It's only one of the various fish management tools. Its value will depend on how intelligently the tool is used. The need for stocking should be definitely established before any stocking is done by competent trained fishery biologists through a study of the habitat and the fish population already present.

No address given.

McFadden, J. T. A POPULATION STUDY OF THE BROOK TROUT (SALVELINUS FON-  
TINALIS). Wildlife Monograph 7, 73 pp. 1961.

The brook trout population of Lawrence Creek in central Wisconsin has been under intensive study since 1955. The population is completely self-sustaining; the stream had not been stocked with hatchery trout since 1948.

Semiannual population estimates were made, from which the density and age structure of the stock were determined. In the entire stream, September populations of brook trout ranged from 936 to 1,796 fish per acre and from 49 to 99 pounds per acre, whereas April brook trout populations ranged from 343 to 1,003 fish per acre and from 33 to 75 pounds per acre. Rainbow trout populations ranged from 24 to 109 fish per acre and from 2 to 9 pounds per acre. The greatest stock density encountered during the study was the 234 pounds of brook trout and 13 pounds of rainbow trout per acre in the experimental refuge area after 2 years of protection from angling.

Trout more than 4 summers old were very scarce. The oldest brook trout encountered was of Age Group VI.

Some movement of fish was detected, but the movement was not extensive. More trout moved into the experimental refuge than moved out of it, although the stock density was greater by weight inside the refuge. In downstream areas, some overwinter downstream drift from areas of greater to areas of lesser population density occurred.

Unweighted mean-annual mortality, measured from one September to the next, was 79 percent for Age Group 0, 90 percent for Age Group I, 96 percent for Age Group II, 91 percent for Age Group III, and 75 percent for Age Group IV. Winter mortality (September to April) was of a similar magnitude for all age groups, ranging from 36 to 63 percent for the entire population. Unweighted mean-natural mortality during the summer (April to September) was 35 percent for Age Group I, 9 percent for Age Group II, and 56 percent for Age Group III. For each male brook trout of Age Group I that survived the winter, 3.3 females survived, although the pre-winter sex ratio was about 1:1. Mortality among males exceeded that among females through the third summer of life.

Average lengths attained by brook trout in September were about 4.0 inches for Age Group 0, 7.5 inches for Age Group I, 9.5 inches for Age Group II, 12 inches for Age Group III, and 14 inches for Age Group IV. Growth in length was nearly linear for fingerlings from February through August, and for yearlings from March to mid-August. Males of Age Groups 0, I, and II exceeded females of corresponding ages in average length. Variations in annual growth from unknown causes were noted.

Most male brook trout become sexually mature as fingerlings and most females as yearlings. The proportion of mature yearling females increased with size of fish. The relationship between egg content and total length of fish was linear for mature brook trout from 4 to 10 inches long.

Samples of eyed eggs and sac fry from excavated redds indicated that more than 90 percent of the fish survive the premergence period.

Pa. State U., University Park, Pa.

Gerking, S. D. PRODUCTION AND FOOD UTILIZATION IN A POPULATION OF BLUEGILL SUNFISH. Ecol. Monog. 32: 31-78. 1962.

The relationship between a bluegill sunfish (Lepomis macrochirus) population and its food supply was described. The abundance, growth rates, and mortality rates of the fish population, the kinds of organisms consumed as food, the quantity of food consumed, and the amount of the food supply was analyzed at Wyland Lake, Kosciusko County, Indiana. This is a miniature, eutrophic lake of 3.18 ha. (6.6 ac.) with a maximum depth of 6 m. (6.5 feet) characterized by thermal and chemical stratification throughout the summer.

Size of the fish population and mortality rates were estimated by mark-and-recapture procedures. The population did not change in size during the two years of the study, 1955-56. The bluegills were twice as abundant as the nine other species combined. The bluegill population was large, grew slowly, and had a high natural mortality rate compared with other lakes in the vicinity. The natural mortality rate increased as the fish grew older. Disease and parasitism were probably primary causes of death. Fishing was responsible for a small proportion of total deaths; the rate of exploitation of legal-sized fish over 122 mm. (5 in.) fork length was 13 percent. Growth of the bluegills was one of the slowest recorded in populations from a large number of lakes.

The food turnover, or the amount of food consumed, of the bluegill population was computed from the vital statistics and the results of laboratory feeding experiments. The efficiency of protein utilization for growth and the amount of protein required per unit length gain were each used to compute the food turnover. Growth efficiency was low. The population consumed six times its own weight during the summer.

The fish fed upon a wide variety of invertebrates split between bottom fauna and plankton entomostraca. The dominant forms were Daphnia (26 percent) and midge larvae (45 percent). The diet was the same in both years and among fish of various sizes. Each year the diet shifted from a high proportion of Daphnia in July to a high proportion of midges in August.



Bluegill production was calculated by multiplying the instantaneous rate of growth by the average summer standing crop and adding recruitment to this figure. Midges and "other" diptera accounted for more than half the production of food which was derived from the bottom fauna. Minimum food production was 4 to 5 times the production of bluegills during the summer and on a yearly basis is in the neighborhood of 10 times.

Fish are produced during the five summer months (May - October). Bottom fauna and entomostraca are produced on a 12-month schedule. Yearly food production can be divided into "keep-up" and "catch-up" periods.

Dept. Zoology, Indiana U., Bloomington, Ind.

Lambou, V. W. DISTRIBUTION OF FISHES IN LAKE BISTINEAU, LOUISIANA. J. Wildlife Mgmt. 26: 193-203. 1962.

Samples of the fish population were obtained from Lake Bistineau, a 17,200-acre impoundment, by rotenone poisoning. These were analyzed to determine if fishes were distributed randomly in the lake. Tests were made to determine if the distributions of the number of individuals and number of species differed significantly from the Poisson distribution. The number of individuals for most species departed markedly from the Poisson distribution, and these departures were toward excessive patchiness. Grouping the data by location or habitat type within the lake did not appear to improve the closeness of the distributions to a random one. Considered as a group, the species were not distributed at random. However, when the species were grouped into predaceous and non-predaceous segments, their distributions approached a random one much more closely.

La. Wildlife and Fisheries Comn. Baton Rouge, La.

Montgomery, A. B. HOW TO CONTROL WEEDS IN YOUR FISH POND. Va. Wildlife 23(5): 16-18. 1962.

Aquatic weed control should begin during construction of the lake or pond. A minor expenditure for deepening the entire shore line to a minimum of 2 to 3 feet at this time will be fully compensated for by years of relative freedom from weeds.

Fishery workers have carried out much experimental work on the control of water weeds. Several methods developed are:

1. Water fertilization is effective in preventing weeds in addition to increasing fish production. Through addition of the necessary nutrients, tiny, single cell plants and animals (fish food organisms) are produced in numbers sufficient to eliminate light penetration into the water, thus shading out plant growth on the pond bottom in water depths of approximately 2 feet or more. Fertilization is not effective in eliminating established weed infestations except on submerged plants growing well below the water surface. Due to variations in water quality, climate, and growing seasons, the fertilizer formula and rate of application recommended for the area must be used for good results. Applications should begin prior to, and continued throughout, the plant growing season. It is not practical to fertilize ponds with appreciable water overflow or in which the water chemistry is not compatible with fertilization.
2. Manual removal by cutting or pulling is effective in eliminating emergent type plants, if seed production is prevented. Cutting should begin in early spring and continued as new growth appears. Four to six cuttings may be required during the first year, and in shallow water cuttings will probably have to be continued during parts of subsequent years. Where practical, a fertilization program should be initiated following removal to prevent re-infestation.



3. Exposure of the pond bottom to winter conditions has effected seasonal control of a number of submerged weed species. In areas having severe winters, drainable ponds with adequate water supplies are often drawn down to expose weed infested bottom areas to freezing and thawing. Winter drawdown should be practiced for three consecutive years to eliminate weeds. Unless fertilization is followed, annual drawdowns may be necessary to prevent re-infestation.
4. Chemical treatments have been used successfully in eliminating most aquatic weed species. No one chemical has been developed which will control all aquatic weeds. Different growth characteristics of the types of plants in relation to the water medium and the morphological differences in the two groups of plants make it necessary to carefully select a chemical which will control a given plant under its particular growth conditions. Chemical control is probably the most effective and economical method.

CHEMICAL CONTROL OF SPECIFIC PLANT TYPES					
Plant Type & Plants	Chemical Material	Concentration	Amount to Use	Method of Application	Suggested Equipment
<b>Algae</b>					
Spirogyra	Copper sulfate	0.5 to 1.0ppm*	2.7 lbs. per acre-foot	Drag, broadcast or spray	Back pak spray; burlap bag
Oedogonium					
Hydrodictyon					
Chara					
<b>Floating</b>					
Duckweed	Fuel oil (#2 grade)	100% straight oil	1-2 gals. per acre (attain good coverage)	Fine "mist" spray	Back pak pressure spray or larger power unit with adjustable nozzle
<b>Submerged**</b>					
(Milfoil )	20% 2, 4-D pellets or sodium arsenite as given below	20% active ingredient--8-15 mesh pellets or larger	100 lbs. per acre of weeds	Evenly broadcast	Crank or power driven seeding equipment
(Coontail )					
1(Fanwort )	Sodium arsenite	4 to 5 ppm*	3 gals. per acre-foot	Introduced directly into water at prop-wash of out-board	Drum, valve and hose for gravity flow
(Bladderwort )					
(Parrots feather )					
(Najas )					
2(Elodea )	20% 2, 4-D pellets or 2, 4-D liquid spray as given below	20% active ingredient--8-15 mesh pellets or larger	100 lbs. per acre of weeds	Evenly broadcast	Crank or power driven seeding equipment
(Potamogeton )					
<b>Emergent</b>					
(Watershield )	2, 4-D ester	0.5% spray solution	40-50 gals. of mixture per acre of weeds (50-100 gals. or more of mixture may be required to adequately cover dense stands of plants such as cattail). Thoroughly wet exposed plant parts with fine mist spray	Fine "mist" spray	Back pak pressure spray or larger power unit with adjustable nozzle
(Water lilies )					
1(Lotus )					
(Spatterdock )					
(Smartweed )					
(Waterchestnut )					
(Cattails*** )					
2(Bulrush*** )					
(Pickrel weed )					
(Arrowhead )					

\*ppm--parts per million

\*\*In treating areas for elimination of a combination of broad and narrow leaf submerged weeds, sodium arsenite should be used as it is effective on both groups.

\*\*\*Carrier should be fuel oil (#2 grade)

Probably the most important factor in successful aquatic weed control is persistence. A persistent follow-up program after elimination of initial weed infestations will assure every owner a weed-free pond with a minimum of effort.

Bur. Sport Fisheries and Wildlife, U.S. Dept. Int., Atlanta, Ga.

## Upland Wildlife

Gibbens, R. P., and Pieper, R. D. THE RESPONSE OF BROWSE PLANTS TO FERTILIZATION. Calif. Fish and Game 48: 268-281. 1962.

The effect of fertilization on the growth and utilization of browse plants was studied on a deer winter range in Madera County, California. The effect of N, P, and S, in various combinations, on seedlings and mature plants of wedgeleaf ceanothus and mature plants of mariposa manzanita was investigated. The studies were conducted in 1959-60. During both years precipitation was far below normal.

Fertilization with NP increased the mortality of wedgeleaf ceanothus seedlings, especially those only 1 and 2 years old. Deer did not utilize fertilized seedlings more than non-fertilized seedlings. Fertilized seedlings did not increase in height more than those not fertilized, probably because of the heavy utilization.

Despite the extremely dry conditions, mature, heavily hedged wedgeleaf ceanothus plants on an old wildfire burn responded to fertilizers by increased twig growth. Carryover effect was evident only when N and P were in combination. Growth response of mariposa manzanita was measured for only one season. All of the fertilized plants produced significantly more twig growth than those not fertilized.

The reduction in twig length by deer was used as an index to utilization of the mature plants. Sulphur-fertilized plants of wedgeleaf ceanothus were browsed significantly more than control plants and most of the other fertilizer treatments. Fertilized plants of mariposa manzanita, a species low in palatability, were utilized more than control plants. The rather consistent preference by deer for fertilized plants indicates that fertilization may be an effective means of increasing palatability.

Analyses of leaves collected from wedgeleaf ceanothus plants showed a consistently higher nitrogen content in leaves of ammonia-phosphate-fertilized plants. Phosphorus content was consistently lower for the fertilized plants, possibly due to a dilution effect resulting from stimulation by nitrogen.

Since fertilizers may be used to increase growth and palatability, cause selective thinning and browsing, and improve watershed values, they offer the game manager an effective tool for habitat manipulation on brush ranges where soil fertility is limiting.

U. Calif., Berkeley, Calif.

Greeley, F. EFFECTS OF CALCIUM DEFICIENCY ON LAYING HEN PHEASANTS. J. Wildlife Mangt. 26: 186-193. 1962.

The failure of pheasants to become widely established on acid soils in the eastern United States, especially along the southern edge of the range, has led to the hypothesis that calcium deficiency prevents successful establishment of the birds. To determine the effects of calcium deficiency on hen pheasants, levels of calcium ranging from 0.37 to 2.34 percent of the diet were fed to hens during the breeding season. Reductions in the rate of egg production, the amount of ash in the leg bones, and in the thickness of eggshells were observed

at 1.09 percent, and less, of calcium in the diet; egg size and bone weight declined to a lesser extent. Hens which produced few eggs on a low-calcium diet lost more weight than hens which produced many eggs on a high-calcium diet. The bone-ash content and eggshell thickness of wild hens from thriving populations in central Illinois were equivalent to those found in the experimental hens with 2 percent, or more, of calcium in their diets. These data were indicative of a positive calcium balance in the wild hens. Hens released in winter south of the pheasant range and collected during the subsequent breeding season showed no evidence of a decline in bone-ash.

### III. Natural History Survey, Urbana, Ill.

Hubbard, R. L., Zusman, P., and Sanderson, H. R. BITTERBRUSH STOCKING AND MINIMUM SPACING WITH CRESTED WHEATGRASS. Calif. Fish and Game 48: 203-208. 1962.

On a good site, maximum bitterbrush stocking should be less than 2,200 plants per acre. Above this level, plants compete critically for soil moisture and space. Competition may not take effect while the plants are small and need little moisture. In the study plot, bitterbrush plants approached mature size before losses from lack of moisture occurred. The time needed for competition to develop is the main reason that plant condition proved to be a more sensitive measure of competition effects than plant size.

Competition between seeded bitterbrush plants probably will not destroy a stand. The stronger plants achieve dominance and the weaker die until, eventually, the stocking is in balance with the site. But all this takes important time that: (1) Gives the more undesirable plants a chance to invade and enter the fight for critical moisture; (2) gives a longer time before plants become large enough to produce useful amounts of herbage; and (3) every year of delay means a grazing loss. Even the potentially dominant plants may be so reduced in vigor that they are easily damaged by grazing, insects, or disease.

Between overstocking and understocking with bitterbrush, slight understocking is preferable. Then the plants will be vigorous, will mature rapidly, and will produce herbage earlier. The crux of the problem is to set the minimum below which a seeding is a failure--the point where the value of herbage produced is not enough to offset the cost of establishment. This isn't an easy point to determine because: (1) Bitterbrush seedings are mainly for game use, and dollar values are not available for this type of grazing; and (2) it is difficult to determine herbage production.

Natural bitterbrush stocking is considerably below the 2,200 plants per acre we recommend. In a study of natural bitterbrush stands in northern California, E. C. Nord found 778 plants per acre on the average and a maximum stocking of 1,420 plants.

Bitterbrush and crested wheatgrass should be planted at least 2 feet apart. This rules out planting grass and bitterbrush from alternate drill rows. Probably the best approach, where both grass and bitterbrush are desired, is to plant a drill width of bitterbrush, skip two or three feet and plant a drill width of grass. This has the advantages of creating more "edge" and making the brush stand less susceptible to wildfire. The plants within two to three feet of the weeded strip had fewer dead branches and were both taller and wider than the others.

Pacific Southwest Forest and Range Expt. Sta., Berkeley, Calif.



The abundance and distribution of scaled quail along with their foods, feeding and nesting habits, and cover needs were studied in 3 main vegetation communities. Field studies were conducted continuously from June 1954 to September 1955 and intermittently thereafter until January 1957 in Cimarron County, Okla. During this period, 1,167 scaled quail and 46 bobwhite quail were trapped, leg banded, color-marked, and released for further study.

Native shrub plants as well as manmade structures provided overhead shelter; these 2 kinds of cover were present at 83 percent of 2,048 scaled quail observations. The 4 main nesting sites for 33 of 50 scaled quail nests were dead Russian-thistle, machinery and junk, mixed forbs, and soapweed.

The analysis of 1,204 scaled quail crops from 3 vegetation communities showed that sorghum, Russian-thistle, gumweed, pigweed, sand lily, sunflower, few-flowered psoralea, true bugs, croton, and green herbaceous material were the 10 leading early winter foods. A larger variety of plant and insect foods was consumed by scaled quail in the piñon-juniper community than in the other 2 communities sampled.

Thirteen of 20 leading early winter scaled quail foods were annual and perennial forbs. The other 7 foods included 2 agricultural grains, 2 kinds of insects, a grass seed, a tree fruit, and herbaceous material. Insect material composed 8 percent of the total food intake in 1954-1955, as compared with only 0.8 percent in 1955-1956, and 5.7 percent in 1956-1957.

Scaled quail were found closer to water during the winter than at other seasons. On 4 study areas totaling 15,040 acres, 35 watering areas, or 1 watering area per 430 acres, were found.

Studies were made of the movements of color-marked scaled quail on their winter home range. The average area of 10 winter home ranges, 1954-1955, was 52.3 acres with extremes from 24 to 84 acres. Four of these home ranges were restudied in 1955-1956, and were essentially the same size both winters. Several instances of interchange of quail between established winter coveys were observed.

The extremes of movements of the color-marked quail from each of 3 winter coveys were determined. These movements indicated the approximate boundaries of summer home ranges varied in area from 720 to 2,180 acres and averaged 1,370 acres.

The average clutch size of 39 completed scaled quail nests was 12.7 eggs. Human disturbance accounted for 39 percent of the nest failures. The average brood size for 392 broods in Cimarron County was 10.0 chicks.

In a hunting season bag check sample of 1,219 scaled quail for 3 seasons, there was an age ratio of 2.86 juveniles per adult (74 percent juveniles). The average scaled quail bag per hunter hour increased from 1.1 to 1.5 during the 3 hunting seasons. Despite increasingly severe drought conditions, brood size, juvenile-to-adult age ratios, and rate of hunting success increased in Cimarron County during the study period.

Maintenance and development of suitable cover are important management tools. Existing cover should be maintained and additional cover encouraged by fencing waste and eroded areas. The planting of drought resistant trees and shrubs, especially piñon pine, sand plum, skunkbush, and tree cactus, is recommended. Top pruning of tree plantings helps promote bushy growth. Additional artificial cover, such as brush piles, platforms, post, board, and junk piles, should be placed in blowouts, gullies, and fence corners.

Wilke, L. A. PRICKLY PEAR FENCE. Tex. Game and Fish 20(2): 6. 1962.

Prickly pear cactus has been put to use on the King Ranch in South Texas in more ways than one.

On the King Ranch hundreds of miles of fence line are planted with pear pads of the common variety of South Texas, Opuntia lindheimeri. Experimental work also has been going on with specimens from both Mexico and Hawaii. The pears along the fence not only afford a good barrier against livestock, but provide food sources and protection for birds.

The pear "tunas," provide bobwhite and scaled quail with both food and water. They also are readily eaten by numerous other species, including whitewinged doves, mourning doves, white-tailed deer, javelina, wild turkey, and many varieties of song birds.

When fences are built on the ranch, especially those along highways, cactus is plowed up and planted in deep furrows along the fence line. It sprouts from the joints when covered with soil.

No address given.

Oberheu, J. C., and Klimstra, W. D. LATE SUMMER AND EARLY FALL FOODS OF THE MOURNING DOVE IN ILLINOIS. Ill. State Acad. Sci. Trans. 54: 115-129. 1961.

Investigation of the field habits of mourning doves in Illinois was made on the basis of 1,142 crops obtained largely during the September hunting seasons of 1948-1955. The sample represented 13 counties in central and southern Illinois.

Animal material composed 0.07 percent of the total volume, grit 0.04 percent, and plant seeds 99.89 percent. Only ten food items, composed more than 1 percent of the September diet by volume. Grasses composed 87.0 percent and spurges 10.4 percent of the volume. Cultivated species provided 62 percent of the food.

Yellow foxtail occurred most frequently (58 percent), but wheat and corn comprised a greater volume (46.4 and 13.7 percent, respectively). Four species of foxtail grasses ranked in the first ten food items and collectively provided 23.5 percent of the volume.

Analyses were made to correlate dove food habits with five major soil types represented by counties where crops were collected. Comparative food utilization by doves from the different soil types varied chiefly in the volumes of cultivated species. Correlations with soil type and crop production were not conclusive.

The greatest yearly variations in food consumed were in the utilization of cultivated crops. However, the yearly comparisons were unsatisfactory due to the large number of variables that could not be related to causative factors.

Generally food utilization showed few marked changes from early to middle to late September. A 100 percent increase in corn utilization during the last 10 days of the month reflected a beginning of corn harvest.

Wheat was more heavily utilized by adult birds than young, whereas corn was taken in larger quantity by males than by females. The foxtail grasses were more heavily utilized than spurges by adult birds, while the reverse was true for juveniles.

N.C. Wildlife Resources Commn.

Lay, D. DEER FRUIT IN PINE WOODLANDS. Texas Game and Fish 20(1): 8-11. 1962.

Acorns are widely recognized as important food for deer and other important fruits of trees, shrubs, and vines.

Large trees important for their fruit or mast include oak, beech, black gum, tupelo gum, and hackberry.

Small trees include dogwood, fringe, chinquapin, blue haw, red haw, may haw, holly, deciduous holly, tree huckleberry, sweetleaf, storax, wax myrtle, plum, honey locust, mulberry, and persimmon.

Important shrubs are French mulberry, gall berry, sumach, viburnum, blueberry, and coral berry.

Deer relish the fruit of rattan, grape, smilax or greenbriar, honeysuckle, blackberry, and most other vines.

Recent studies show that some of these species are important enough to justify their space in the forest. And most of them have an advantage over the oaks in that they can grow under pine trees.

There is widespread concern for the reduction in hardwoods, especially oaks, which has resulted from the intensified effort to grow pine trees in East Texas.

Although early timber stand improvement was confined mostly to overstory hardwoods and the major loss to wildlife was in acorn production, the present trend promises to cause reductions in many smaller trees, shrubs, and vines and in their fruit crops.

Land operators who desire to keep some wildlife carrying capacity should save some of the lesser mast producers as well as some oaks.

Wildlife Biologist.

Korschgen, L. J. FOODS OF MISSOURI DEER, WITH SOME MANAGEMENT IMPLICATIONS. *J. Wildlife Mangt.* 26: 164-172. 1962.

Analyses of 578 deer-stomach samples collected from 57 of Missouri's 114 counties were made. Of 272 food items identified, 20 comprised 1.0 percent or more each of the total volume. Principal foods by group and percentage of total bulk are presented in tabular form. Oak mast, grain (mostly corn), and fruits are staple deer foods in Missouri. Use of oak mast was obviously related to availability. In years of mast failure, other foods were taken in much higher proportion. Use of agricultural crops varied by season and year, but averaged 22.5 percent of all food during the study period. A limit of approximately 50 percent farm crops in the deer diet appeared to be the breaking point between crop-damage complaints or lack of them. Coralberry, dwarf and smooth sumacs, red cedar, soybeans, wild grapes, New Jersey tea, asters, and wild lettuce may be used as indicators in determining trends in range condition. Heavy utilization of red cedar and oak leaves by deer showing symptoms of malnutrition in the western Ozarks Region indicated that these items are starvation foods. Mast failure or severe drought may seriously affect Missouri Ozarks deer through reduction of nutritious foods. Stomach analyses showing significant increases in grazed or browsed foods should alert the game manager to necessary herd reduction because of food shortages or over-population.

Mo. Conserv. Comn., Columbia, Mo.

## Wetland Wildlife

Kadlec, J. A. EFFECTS OF A DRAWDOWN ON A WATERFOWL IMPOUNDMENT. *Ecology.* 43: 267-281. 1962.

The effects of a drawdown on the soil, water, vegetation, invertebrates, and populations of waterfowl of an impoundment were determined.



Soil and water analyses indicated a definite increase in plant nutrients. A marked increase in soil nitrates occurred during the drawdown as a result of aerobic nitrification. This effect persisted at least until the spring of the first year of reflooding. The response of other nutrients was less definite, but increases were noted and plant growth improved. The most favorable increase in fertility was obtained when the organic portion of the soil remained moist or even very wet during the drawdown.

Invertebrate populations, a potential food supply for waterfowl, were considerably reduced after the drawdown.

The plant species composition was not notably affected. Most of the common species prior to the drawdown were perennials and apparently able to survive drainage for one growing season. Many of the submerged and floating-leaf species were reduced in abundance. Waterlilies are extremely hardy and were little affected except in areas of very severe drying. Water smartweed and bushy pondweed growth was luxuriant after the drawdown, apparently in response to increases in nutrients.

Most emergent species spread and increased in abundance as a result of the drawdown. Many of these plants require an exposed soil seed bed for germination and early growth and respond rapidly to these conditions provided by a drawdown. Sedges and woolgrass were most abundant on portions which became very dry. Cattail, bulrush, and burreed were more abundant in areas where considerable soil moisture was retained throughout the drawdown. Rice cutgrass and mannagrasses were more generally distributed.

Wetland food production during the drawdown was disappointing. Poor millet and smartweed growth was probably due to the absence of an adequate seed supply and to excessive drying of the bottom soil. Rice cutgrass was abundant but did not produce seed.

Waterfowl utilization of the area increased in the late summer of 1959. Abundant food, principally bushy pondweed, was very attractive to ducks. Observations on other areas indicated that brood production was closely associated with emergent cover of suitable density which persists through the winter. The increased cover developed by the 1958 drawdown in Backus Lake was submerged by reflooding and was not available in early spring of 1959. Use by breeding waterfowl increased in 1960 when the newly developed emergent cover was available.

Rose Lake Wildlife Expt. Sta., Mich. Dept. Conserv., East Lansing, Mich.

Platts, W. S. BEAVER AND TROUT. Idaho Wildlife Rev. 14(4): 6-7. 1962.

Beaver are seldom entirely harmful or beneficial. Beaver activities are usually harmful in lowland streams, canals, and irrigation ditches and generally beneficial in cold, precipitous streams having no spawning runs.

Beaver control, or removal of beaver dams, is a desirable procedure when it has been determined that damage to trout waters is taking place. It should also be ascertained for each situation whether the beaver or the trout is the most valuable.

Beaver and beaver dams should be removed from streams or tributaries of any lake supporting a trout spawning run. A beaver dam that is not active should be removed before adverse effects take place.

Beaver should be protected and introduced into trout waters located in very cold precipitous streams not having spawning runs.

Different ways beaver may be harmful are: (1) Blocking trout migrations (spawning runs); (2) unfavorable raising of stream temperatures by impounding water and eliminating stream side cover; (3) changing water quality; (4) reducing stream flow; (5) providing favorable conditions for predators, competitors, and parasites; (6) flooding and siltation of spawning beds; and (7) deposition of silt downstream when the dam washes out.

Different ways beaver may be beneficial are: (1) Providing rest, food, shelter, and wintering pools for trout; (2) providing an increased bottom area favorable to the production of trout food; (3) stabilizing stream flows; (4) raising water temperatures in cold streams; (5) providing more fishing area; and (6) increasing esthetic value.

Conserv. Officer, Malad, Idaho.

## SUPPLEMENT

### Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

Youngson, C. R., and Goring, C. A. I. DIFFUSION AND NEMATODE CONTROL BY 1,2-DIBROMOETHANE, 1,3-DICHLOROPROPENE, AND 1,2-DIBROMO-3-CHLOROPROPANE IN SOIL. Soil Sci. 93: 306-316. 1962.

Nematode control by 1,2-dibromoethane, 1,3-dichloropropene, and 1,2-dibromo-3-chloropropane was studied by techniques designed to simulate commercial methods of application and field conditions.

The inherent diffusivities of the three fumigants, calculated from their vapor pressures and solubilities in water, decrease as follows: 1,3-dichloropropene > 1,2-dibromoethane > 1,2-dibromo-3-chloropropane.

For all the fumigants, basic toxicity to the nematodes was a product of concentration and time, the relationship was best accomplished by 1,3-dichloropropene.

With an injection depth of 6 inches, a 12-inch distance between streams, and a variety of soil conditions, major variation in nematode control occurred in the vertical but not in the horizontal direction in a sandy soil. Similar results were obtained with 1,2-dibromoethane in a clay soil. At low dosages, maximum nematode control was obtained at a slightly below the injection line. With increasing dosages, control was extended to a much greater extent below than above the injection line. At a sufficiently high dosage, nematode control was obtained to the surface of the soil. Nematode control was improved by increasing the injection depth of 1,2-dibromoethane from 3 to 6 inches.

The rate of diffusion of the fumigants through soil decreases with decreasing porosity. With 1,3-dichloropropene, the most rapidly diffusing of the three fumigants, improved nematode control was obtained at the lower porosity. With the more slowly diffusing, 1,2-dibromoethane, better nematode control was obtained at the high porosity for the short incubation period. For the longer incubation period, however, nematode control was similar at both the low and high porosities. With the most slowly diffusing 1,2-dibromo-3-chloropropane, better nematode control was obtained at the high then at the low porosity, regardless of the length of the incubation period up to 42 days. The porosities studied varied between 27 and 53 percent.

With porosities ranging from 30 down to 5 percent, diffusion and nematode control by 1,2-dibromoethane was increasingly restricted. However, even at a porosity of 5 percent, some nematode control was obtained. In a simulated field situation with high porosity (40 percent) in the top 6 inches and low porosity (11 percent) below 6 inches, better nematode control was obtained by splitting the dosage of 1,2-dibromoethane, between injection depths of 6 and 12 inches, as compared to applying the whole dosage at either injection depth.

The basic toxicity of 1,2-dibromoethane to root-knot nematodes was highly temperature-dependent, nematode control decreasing with decreasing temperature. The basic



toxicity of 1,2-dibromo-3-chloropropane was only slightly temperature-dependent, while that of 1,3-dichloropropene was independent of temperature over the temperature range tested (50° to 90° F.). In a simulated field situation, the most important effect of the influence of temperature on nematode control was its effect on the basic toxicity of the fumigant not its effect on the rate of diffusion of the fumigant.

In a simulated field situation, the addition of 5 percent manure caused a considerable decrease in root-knot nematode control by all three fumigants. In basic toxicity tests, similar effects on nematode control were obtained with all three fumigants when 2 percent additions to the soil of a wide variety of fresh plant materials was used. Certain materials, namely alfalfa, barley, and flax were extremely deleterious to the nematocidal action of 1, 2-dibromoethane.

Dow Chemical Co., Seal Beach, Calif.

Anonymous. POTABLE WATER DIRECTIONS FOR DISINFECTING A WELL. N.J. Agr. Expt. Sta. C. 598, 4 pp. 1962.

A common problem with New Jersey well waters is bacterial contamination. These bacteria may or may not be harmful. Since it is difficult to test a well water for all types of harmful and harmless bacteria, a certain group, known as the coliform bacteria, are used to indicate possible contamination. These coliform organisms live in the intestinal tract of warm-blooded animals, (e.g. man), hence they are excreted in large numbers. Any well water that shows the presence of coliform bacteria is considered contaminated and should be disinfected.

Well waters may become contaminated by coliform bacteria from any of the following conditions: (1) Loose or worn seal on drilled and driven wells; (2) defective or inadequately sealed casings in drilled and driven wells; (3) cracked or loose fitting cover on a dug well; (4) defective wall lining, or cracked concrete apron of a dug well; (5) repair to well structure or submerged pump; (6) flooding of the well due to hurricanes, floods, heavy rainfall, or other natural disasters; (7) breakdown and repair of a septic tank system; (8) wells drilled into fractured rock formations; and (9) wells located in areas where ground waters are subject to continuous contamination from outside sources.

Well waters should be disinfected whenever any of the following situations prevail: (1) Suspected contamination by any one of the nine conditions listed above; (2) after repair to an existing well or pump; (3) after construction of a new well and before any water is used; and (4) upon receipt of a laboratory report showing an unsafe coliform bacteria analysis.

Directions are given for temporary disinfection by boiling the water and chlorination, and permanent means of disinfection by "home chlorinators."

N.J. Agr. Expt. Sta. Col. Agr., Rutgers--The State U., New Brunswick, N.J.

Faust, S. D. WATER FROM HOME WELLS; PROBLEMS AND TREATMENTS. N.J. Agr. Expt. Sta. C. 594, 20 pp. 1962.

Water from a well may contain chemicals that cause problems. For example, there are hard waters that form scales; soft water that may be acid and corrosive; iron-bearing waters; and colored, turbid, off-flavored, and odorous waters. This circular recommends water treatment methods that will help provide palatable water for the family and protect the water distribution system at the same time.

The general chemical characteristics of New Jersey ground waters are given.

N.J. Agr. Expt. Sta., Col. Agr., Rutgers--The State U., New Brunswick, N.J.



## Radioactive Fallout

Agricultural Research Service. PROTECTION OF FOOD AND AGRICULTURE AGAINST NUCLEAR ATTACK: A GUIDE FOR AGRICULTURAL LEADERS. U.S. Dept. Agr., Agr. Res. Serv. Agr. Hbk. 234, 41 pp. 1962.

If a nuclear attack were to be made upon the United States, all segments of our population and of our economic structure would be affected.

Agriculture would share the Nation's total difficulty and still be faced with special problems. The United States Department of Agriculture, in cooperation with other agencies of Federal and State governments, is responsible for helping to develop means by which farm people could cope with these special problems for their own protection and to maintain farm production in times of emergency. The Department participates in devising active defense and implementing actual protective programs, in conducting research to provide the knowledge on which these programs are based, and in keeping farm people and agricultural leaders informed about them.

One of the major parts of the defense plan being developed against nuclear warfare is aimed at reducing potential hazards from radioactive fallout. What is known about the effects of fallout on agriculture and what defensive measures can be taken against them were given. The information, including tables and denial times, is based on emergency conditions, not those prevailing in times of peace.

A glossary of terms is included to aid in a fuller understanding of such terms.

ARS, USDA, Inform. Div., Washington 25, D.C.

Evans, E. J., and Dekker, A. J. COMPARATIVE SR90 CONTENT OF AGRICULTURAL CROPS GROWN IN A CONTAMINATED SOIL. *Canad. J. Plant Sci.* 42: 252-258, 1962.

In a greenhouse study in which 36 species of plants, including cereal crops, forage crops, and vegetable crops, were grown in a soil contaminated with Sr-90, considerable variation was found in the Sr-90 content of samples of botanically unrelated species. The Sr-90 content varied directly with the calcium content of plant samples, and consequently the Sr-90/g. Ca was reasonably constant for most species when similar morphological parts of the plants were compared. Cereal grains were lower in Sr-90 content than were the straw samples whether the results were expressed on the basis of a unit dry weight of sample, or a unit weight of Ca in the sample. As a group, legumes contained higher amounts of both Ca and Sr-90 than did grasses. Forage grasses were similar in Sr-90 content to the straw of cereals. Although the tops of root crops contained more Sr-90 than did the roots on a unit dry-weight basis, the roots contained more Sr-90/g. Ca. The Sr-90 contents of potato tubers and cereal grains were among the lowest of the samples measured.

Canada Dept. Agr., Ottawa, Ontario, Canada.

Jones, J. B., Jr., and Haghiri, F. REDUCING THE UPTAKE OF Sr<sup>90</sup> BY PLANTS ON CONTAMINATED OHIO SOILS. *Ohio J. Sci.* 62: 97-100. 1962.

Thirteen soil samples representative of the Hoytville, Miami, Alexandria, and Muskingum soil series in Ohio were studied. The samples were subdivided and limed at various rates to establish a pH range of approximately 5 to 7 for each soil type. Five of the soils had initial pH values of less than 5, while the remaining soils ranged from 6 to 7. The  $\mu$ c of carrier-free Sr-90 were thoroughly mixed into each soil sample, and the soils were cropped in the greenhouse in sequence with corn, soybeans, wheat, and alfalfa. The aerial portions of the plant were harvested when 6 to 10 in. tall and the amount of Sr-90 in the plant samples was determined.

The results indicated that the amount of Sr-90 entering the plant from a contaminated acid soil was significantly reduced by liming. In addition, texture strongly influenced the amount of Sr-90 absorbed by plants. As the clay content of the soil increased, the Sr-90 uptake decreased. The uptake of Sr-90 from an acid soil appeared to be equally influenced by soil texture and liming. The Sr-90 content of plants can be effectively reduced by: (1) Liming; (2) growing crops in soils high in clay content; and (3) selections of plant species which are low accumulators of strontium.

Ohio Agr. Expt. Sta., Wooster, Ohio.







